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PAPERS & PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

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TASMANIA,

FOR

1896.

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Proceedings OF THE Royal Society of Tasmania.

THURSDAY, MAY 28, 1896.

The VICE-PRESIDENT (the Hon. Sir James Wilson Agnew, K.C.M.G. M.D., M.F.C.), in the chair.

The first monthly meeting of the Royal Society of Tasmania for the 1896 session was held in one of the art galleries of the Museum.

The VICE-PRESIDENT (Sir James Agnew) expressed his pleasure at seeing such a large attendance, and thought it augured well for the support that would be given during the session. Like all other institutions, the Royal Society had suffered by the financial depression, but which he hoped and believed was now passing away. He was, at any rate, glad to say that some who had temporarily left the society had resumed their allegiance, and it was hoped that, in addition, a number of new recruits would be secured during the present session. He felt that many more in the community might, and should, with advantage, join the society. Much of the hesitation in doing so, which unfortunately existed, was groundless. There seemed to be an impression abroad that only subjects in the more severe walks of science were discussed; but as all who belonged to the society could testify, any subject appertaining to the good weal of the community was open to consideration, and that fact should result in more support being secured. For instance, that evening the first paper to be read would have reference to the health of the community. It was a subject that had been before them on more than one occasion, it being regarded as one of the very first importance. If it could be shown, as he believed Mr. Johnston in his paper would do, that the health of this metropolis and the salubrity of the colony generally was not to be surpassed in the world, the establishing of the fact must prove one of considerable importance financially and otherwise to the colony. If that be so, if its great salubrity was so established, Hobart might be chosen as the federal capital of the Australias. If the society, through Mr. Johnston, as one of its members, spread the truth as to the healthiness of Hobart, it would deserve well of the public of Tasmania. They were brought into contact with institutions throughout the scientific world by the exchange of publications. There were five new members to be balloted for, namely, Mrs. Agnes Kenyon, of Melbourne; Dr. Arthur Clarke; Mr. W. H. Twelvetees, F.G.S., of Launceston, who would prove a most valuable working member; Dr. G. Crosby Walch, and Dr. Gregory Sprott, the City Officer of Health.

“THE HEALTH OF HOBART.”

By R. M. JOHNSTON, F.L.S.

Mr. R. M. JOHNSTON first explained a number of diagrams placed on the boards. The first showed the mean death-rate in seven European countries for several years, and of the Australian colonies, including Tasmania. This showed that all these colonies had a lower death-rate than even the most favoured European country of Sweden.

There was, Mr. Johnston said, a superterrestrial influence in addition to other influences that affected the death-rate in certain years, and which interfered with the death-rates independent of such local influences as sanitation, accidents, war, etc. The next diagram showed what affected the health and the death-rate, independently of other matters that pertained to artificial arrangements. This demonstrated the necessity for having death-rate tables prepared which did not merely show the total death-rate of a city or country. The total death-rate was in itself an uncertain index of the comparative health, because, primarily, it concealed the true cause or causes which produced a high or low total death-rate, mixing up deaths from non-preventable causes (old age, or the natural termination of a healthy life) with deaths from preventable causes; it ignored the influence of migration, which, introducing a large proportion of young people, may lower the total death-rate by as much as 3 or 4 per 1,000 persons living without the slightest alteration in the percentage dying at each age, or of any cause affecting preventable disease. The normal natural death-rate varies extremely with age in every place and country. In young lives under 5 it varied in Australasia in a favourable year—1893—between 26·96 and 41·45 per 1,000 living, with a mean of 37·37 per 1,000 living. The death-rate for ages between 5 and 65 years ranged from 5·90 to 8·84 per 1,000 living, with a mean of 6·84 per 1,000 only. On the other hand the death-rate of lives 65 and over ranged from 69·42 to 80·44; with a mean of 76 per 1,000 living. It therefore followed that it entirely depended upon the proportions of people living at each age, whether the total death-rate is high or low, even where the specific rate at each age-group is the same, and where the health-rate for each specific cause is equal. A high total death-rate is simply inevitable, therefore, if the proportion of old ages in any country or town be abnormally large, even if it were the healthiest country or city in the world. This is the true reason why Hobart suburbs have invariably a much higher death rate than the Hobart city, and why the death-rate of Hobart and suburbs is a little higher than Sydney, Brisbane, and Wellington. A diagram was presented showing the typhoid death-rate in Hobart. It rose in 1887 to an extreme point, due to causes which could not be explained, whilst during the last three years it had been very low. Then came the diagram showing the mortality from preventable diseases, and indicating a great fall in the numbers during the past 10 years. Then came a table showing how there was the same rise and fall in the number of typhoid cases in the other colonies, proving that there were other unknown influences at work irrespective of anything local. Mr. Johnston referred in detail to the typhoid fever epidemic of 1887. It led to a keen inquiry as to the sanitary condition of the city, many believing it was due to local causes, such as defective drainage, but there was something beyond that. During the last three years, fortunately, the city had been very free from typhoid. Indeed, the death-rate from preventable causes had never been so low before, and had had the effect of raising the city into a healthier state than that of any other period in its history, and had constituted it pre-eminently as among the healthiest cities in the world. Yet, there was no doubt the sanitary provisions had had very little to do with it, for there was a similar decline, correspondingly, in the other Australian cities. The cause of this decline must be common to all. In regarding the healthfulness of Hobart they must make clear the difference between a total death-rate and a health standard, as already indicated; as over 20 per cent. of the total death-rate of Hobart is composed of the numbers of those who die of old age it may be seen how misleading it would be to compare its health with the other cities named on the basis of total death-rate from all causes, including

preventable and non-preventable. Indeed, if there be anything to fear in our death-rate statistics, it is that anyone who comes to reside in this city has the chance of one in five that he will prolong his life to extreme old age. The rate of 12·81 per 1,000 persons living is a remarkably low death-rate for any city in respect of all preventable causes of death. It is lower than the average of the preceding 10 years by 26 per cent., and lower than that of the epidemic year by 33 per cent. Statistics were quoted to show the favourable position taken by Hobart as contrasted with 65 principal towns in Great Britain and Australasia, and it was shown that its infantile mortality is by far the lowest of all, as in all deaths from every preventable cause. The official statistics quoted conclusively established the fact that the present health condition of Hobart has never been so good, and that it is pre-eminently one of the most healthy cities in the world. Every care had been taken to make a particular and thorough contrast of all the principal causes of preventable diseases, and the results shown are so obvious that even the most ignorant or the most sceptical who gives the matter any attention cannot fail to be convinced by them, and that figures logically, carefully, and consistently arranged are most eloquent agents in support of truth is not in any way affected by the vulgar platitude that "figures may be made to prove anything." The inhabitants of this beautiful city, instead of unreasoning expressions of discontent with their present local condition, should be indeed grateful to God that there are few, if any, cities of the world that enjoy such highly favourable health conditions and so genial a climate. Those who praiseworthy endeavour to increase and maintain the good health of the city, by care and improvement of all sanitary provisions, should not mar their good work by giving any encouragement to unwarranted alarmist statements regarding the good fame and health of the city we live in, and which, at present, is the most healthy of any city he knew of.

It was agreed to postpone discussion on the paper till next meeting.

Mr. J. Douglas Ogilby, of Sydney, read a paper on "Some Tasmanian Fishes." Having had occasion some time ago to compare certain Tasmanian fishes with their New South Wales representatives, Mr. Ogilby applied for assistance to Mr. Alex. Morton, curator of the Tasmanian Museum, who, the writer of the paper said, "with a commendable promptitude and liberality which, with advantage to Australian biology, might well be imitated, forwarded unreservedly a number of the required species," with the suggestion that Mr. Ogilby should embody the result of his researches in the form of a paper to the Royal Society of Tasmania. This paper was the outcome of that suggestion, and dealt with several of the more interesting fishes received from Mr. Morton, special attention having been given, as requested, to the *Mugilidæ*, or mullet family.

MICROSCOPICAL STUDIES OF TASMANIAN ROCKS.

BY MR. W. H. TWELVETREES, F.G.S., LAUNCESTON.

The writer referred to the delicate methods of modern microscopical petrology having added greatly to our knowledge of igneous rocks. The efforts of the writer in connection with the Launceston Microscopical Club have been entered upon in the hope of throwing additional light upon the genesis and intimate structure of our eruptive rocks. It is

purposed to continue the descriptions from time to time as materials and opportunity permit. The paper first dealt with the dolerite ("debase" of authors) of the Cataract Gorge, Launceston, the samples of rock selected for slicing having been taken from the quarry near the Cataract Bridge. The essential mineral components are a plagioclase feldspar, augite, and a little iron oxide. The feldspars are mostly turned out on the albite plan, and belong to the labradorite-anorthite group. The augite is a group of large, ill-defined crystals moulding themselves, as it were, upon the feldspars. With regard to the genetic history of the rock, its microscopical structure shows that it cannot in any sense of the word be described as a lava poured out at the surface in ancient times and cooled under atmospheric conditions. The crystallisation indicates its formation below the earth's surface. The rock agrees thoroughly with what is called the intrusive type, intermediate between the plutonic rock masses and volcanic lavas emitted at the surface. The Zeehan white rock (a vesicular basic lava—melaphyre) varies in appearance according to the degree of decomposition, and to its condition as an ancient ash or a tuff or lava flow. The stone tested was obtained from the Silver Queen mine through Mr. W. F. Petterd, who is quite satisfied that the rock embedded with the schists. The reader of the paper described how they were led to include the stone among the glassy melaphyres. Melaphyre is regarded by English petrologists as altered basalt, and in this sense the Zeehan stone is the vesicular form of old basaltic eruptive material altered into vesicular basalt—vesicular melaphyre. The microscopical characters teach us that it is an old lava, and Mr. Petterd has stated that he has been able to satisfy himself that it is interbedded with the slates; that in one of the adits of the Oonah mine it can be distinctly seen lying between the slates and following their stratification. Picrite from Mount Horror was the next class of rocks considered. This is a small class composed of the ferro-magnesian silicates, and containing little or no feldspar. These are the ultra-basic rocks. The most important mineral is augite. The purple colour results from the presence of titanitic acid. Having given a full description of the nature and affinities of Mount Horror picrite, the writer concluded that its structure is coarser than that of a dolerite, and by its constitution it is an augite-olivine feldspar rock. Its relations are evidently with the olvine-dolerites, and connected with the ultra-basic rocks. The paper may serve to direct attention to this instance of a picrite in Tasmania, and elicit the communication of further occurrences.

Hon. ADYE DOUGLAS (the President of the Legislative Council) moved a vote of thanks to the Vice-President, speaking most highly of Dr. Agnew, with whom he had been friendly since 1840.

His Honor the CHIEF JUSTICE (Sir Lambert Dobson) seconded, and included the gentlemen who had contributed the three papers. According to Mr. Johnston, Tasmania was the best country in the world for babies and old men. We had no right to be alarmed at the report of diphtheria that spread some time ago, and he was satisfied that Mr. Johnston's paper would do Tasmania a great deal of good, for in Tasmania we were too apt to decry what we ought to praise and value—our climate and situation.

The resolution was passed with acclamation, and the meeting terminated.

MONDAY, JUNE 15, 1896.

The PRESIDENT (His Excellency Viscount Gormanston, K.C.M.G.), in the chair.

There was an unusually large, influential, and representative gathering on Monday at the monthly meeting of the Royal Society of Tasmania. Prior to the commencement of the meeting a handsome memorial fountain to the memory of Sir Robert Hamilton, K.C.M.G., LL.D., the late revered Governor of the colony, erected in the vestibule of the Museum, was unveiled, the ceremony being performed by His Excellency Viscount Gormanston, K.C.M.G., the present Governor.

The following gentlemen were elected Fellows:—Messrs. Cecil Anderson, A. D. Watchorn, Wilfrid Giblin, M.R.C.S., R. Templeman.

Dr. MONTGOMERY, Bishop of Tasmania, read an interesting paper on "A Night in a Petrel Rookery." On February 29 last an opportunity presented itself of enabling him to observe the habits of the sooty petrel in its breeding places, and he availed himself fully of it. Happening to be at Big Dog Island he walked down to the rookery at 2.30 a.m. under a full moon to watch the birds till they left their young for the day. A day or two later he sallied out at 9.30 p.m. and stayed till 2.30 a.m., completing, in this way, a night's observation. His experience was the same as that of residents in the locality. He was convinced that the petrels came back to their young silently. So silently that it has a ghost-like effect, in order to give as little notice as possible to their enemies, the big gulls, and to the crows. Hundreds of thousands of birds flash up from the sea and disappear into their holes just as it is becoming dark, without uttering a note. The only disagreeable characteristic of this graceful bird is its hideous cackle. For at least an hour, up to 10 p.m., the gurglings and hoarse noises continue. Then silence falls on the rookery. The young birds are digesting, and the old birds are resting. But the parents are not all in their holes. A great many come out almost immediately, and walk about amongst the warm long grass. Finally, a great many sleep in the open air. He had spent a long time in stepping about among these sleeping birds as they crouched on the ground. They do not put their heads under their wings. At times a bird would walk up to him and stop at his foot, unconscious of danger, but the slightest movement made them scuttle away like rabbits, for they were quite unable to fly off the level ground. It is wonderful how fast they can run down a track. He had seen a young fellow find it difficult to keep up with them. He saw them dance their ghostly quadrille previous to their departure seaward in the early morning. The young birds (numbering many hundred thousand) were hushed in complete silence underground. At 5.19 a.m. all the birds had disappeared to seaward. At 5.23 a.m., just 4 minutes after the last petrel had disappeared, he heard the wailing of a Pacific gull. In 20 minutes more a squadron of those great creatures, accompanied by as many crows, came reeling over his head, quaking, wailing, and quartering the ground carefully to see if any belated petrel could be discovered. If any old bird is late he makes for a hole, and does not stir out of it all day. Dr. Montgomery followed with an accurate account of the habits of the sooty petrel from the day it returns to breed in the Bass Straits to the time when it flies away, in all probability to Arctic regions. The sooty petrel returns to breed about September 17, having paired already. They commence at once to scratch out their holes, the process lasting off and on for about six weeks. One bird is always seen to be at work, but whether the work is divided is not known, though in all probability the labour is shared. They do not stay on the island in

the day time, but come and go when it is dark, because they live in constant dread of the gulls and other enemies whilst it is light. If one is caught by the daylight it retires to its hole and does not stir till nightfall. The petrels depart about November 1, and are seen only occasionally till November 20, when they come back in countless thousands to lay their eggs—one for each pair. The earliest period for the egg that he has heard of is November 18. Big Dog and Little Green islands are early islands for them. The egg is white and rather larger than a duck's egg. If the egg is taken the bird does not lay again. If some young birds are taken the old birds still return at night till the first flight for the southern latitudes commences. The eggs, if left in the hole more than three days, are not good for eating, but if secured at once they may be kept for some weeks. If the old birds, on coming back, discover that their young have been taken, they disgorge the oil meant for their offspring. During the period of incubation the parents take it in turns, sitting for a week and then exchanging. The young bird appears about June 15—that is, two months after the egg has been laid. These petrels do not live on fish as a rule, but on small sea creatures such as shrimps or the berries of kelp, also, doubtless, on very young fish. The baby petrel is in danger for a fortnight or so from snakes, and a certain number are destroyed. The holes are about 2ft. or 3ft. deep. It was asserted to him by both white and half-castes that when the feathers of the young birds are well grown (about the last days of April) and they are able to fly, their parents wholly desert them, leaving them to find the water and food themselves. When the young birds have been left for a week starvation forces them out of their holes. It is also attested by all that as soon as the young bird emerges from its hole, driven forth by hunger, it commences to swallow gravel, and it is unanimously asserted that until the young petrel has ballasted itself with gravel it can neither swim upright nor fly. A great many young birds fall victims to their enemies, yet the sea is black with them in May, and it is computed that out of 300,000 young petrels in a rookery, fully 100,000 escape in safety to join their parents somewhere near the South Pole. The birds visit our shores only to rear their offspring.

The second part of Dr. Montgomery's paper had reference to mutton-birding, a unique industry, and only carried on in the Furneaux Islands as a regular one. It is likely to assume still larger proportions. The "birding" begins on March 20. Before that date the temporary huts of the workers have been repaired, and wood and water stored. An average family attempts to catch and salt about 450 birds a day. On wet days it is impossible to work, and even in fine weather the destruction of clothing is great. A new hand finds himself almost garmentless after a few days of work, which consists of crawling about among rough bushes and lying extended upon the ground, burrowing with the arm into deep holes. Whether this industry will ever be popular on islands where there are snakes is doubtful. Babel Island, where the birds are most numerous, is virtually unvisited at present, and swarms with snakes. The regulations of the Government, the Bishop considers, are adequate for the protection of these birds. Families on Chappell Island exult in the capture of not more than about 200,000 young birds out of a possible 300,000, leaving a very fair margin. As a good many islands on the Australian shore have no water and no boat harbours, and swarm with birds, there is no prospect of their destruction. As regards the salted birds, it may be as well to point out to possible consumers that they are all young, that they have fed on nothing but oil, and have never left their holes except to die. The process called "fattening" ought to be discouraged. It is only resorted to by a few families, and the general sense of the island community is against them. The "fatter" catches his bird, empties

the oil into a can on the rookery, and brings the carcasses down without any care to the boilers, into which they are thrown, and boiled down for the fat alone. It means that a family can take 1,000 birds for this process, whilst the salters can capture only 500. The flesh of these birds is nutritious, and readily finds a market, and Government has been wise in regulating it. As time goes on the rules will have to be made more stringent, but there is no need to move too fast. The time is coming when the number of hands birding on Chappell Island will have to be restricted. The number of families grows as the half-castes increase, and probably the limit of the workers has already been reached. This island has always been looked upon as a sort of perquisite for the half-castes, and rightly so in his (Dr. Montgomery's) opinion ; but the number of half-caste workers must soon be restricted in their own interests, and he was glad to note that the older men have this year been suggesting that younger families should go to Babel Island, on the east coast of Flinders. It is much to be desired that the old birds should be protected whilst they are feeding their young. At the present time it is the custom in February and March to catch the old birds at night for consumption till the breeding season commences. It is feared that many thousands of these parent birds are thus caught. Doubtless it would be better to protect all the eggs, but inasmuch as they are not now permitted to be sold, and as they are only fit to eat for two or three days after they are laid, and are supposed to be eaten on the spot, no great amount of harm can be done. He imagined that the capacity of a half-caste cannot equal that of the Tasmanian pure aboriginal, one of whom, it is said, was seen to consume 52 eggs in one day.

Several views, by the aid of a lantern, were then thrown on the screen, whereby Dr. Montgomery illustrated the islands, the mutton birds, half-castes, etc., and which proved very interesting.

The discussion on Mr. Johnston's paper on the health of Hobart was then opened by Mr. MAULT, who spoke of it as a singularly able paper. The speaker claimed that the general reduction in the number of cases of disease was due to the passing of a Health Act in each of the Australian colonies and its administration. The statistics given by Mr. Johnston showed that the cases of typhoid fever should be fewer in such an otherwise extremely healthy city. Sydney was in advance of Hobart in that respect. He referred to how sanitation had reduced the number of cases of fever in the old country, and insisted that if improved results were obtained elsewhere, why not in Hobart? As regards phthisis, emphasis should be given to the fact of Hobart's freedom from it. The number of cases stood the lowest in the list of all the cities instanced in all parts of the world. In respect to all diseases connected with the lungs Hobart was the lowest of any of the many towns he had mentioned, and the place should prove a very fitting one for a sanatorium for consumptive cases.

Major-General TOTTENHAM said it seemed to him that there was one other matter which required consideration as a factor in the judgment of healthiness of a place or district, whether as to natural or artificial conditions. He disclaimed any desire to decry or to fix the stigma of unhealthiness on Hobart. He came to Hobart 11 years ago hardly able to walk half a mile at a snail's pace, and his tolerably known capacity in locomotion now needed no statistics to attribute to the healthful air of Tasmania. It was a deep debt of gratitude which had impelled him to advocate so strenuously and persistently improved sanitation in Hobart, in order that the health of the city—the healthiest he had ever seen in the world, and he had seen a good many—should be rendered still healthier. What he complained of was the existence in past years of preventable disease unwarranted by

the exceptional advantages of the site, and due, in his opinion, and not in his alone, to municipal neglect of sanitary laws. Mr. Johnston had placed before them a series of tabular statements, the burden of each being a death-rate. Those tables showed undoubted statistical acumen and patient research. The "mortality of disease" was well set forth, but he (Major-General Tottenham) had searched in vain for the "prevalence of disease," as indicated by the number of cases of preventable disease occurring in each city reviewed. The exclusion of only "old age and senile decay" from preventable causes classified all other deaths amongst the possible. That, unintentionally no doubt, gave a false view as regarded "sanitary state," for diseases were due to public as well as private responsibility or neglect of such. The ordinary acceptance of the term "preventable disease" was disease by governmental or municipal decree, so to speak. There should be no municipal or government neglect in this respect. The mere death-rate of a place could not be regarded as a fully trustworthy test of its healthfulness. All the fever cases in Hobart were not notified, and the speaker gave statistics to support his contention. As Mr. Johnston had indicated, without accurate statistics they could not know, prove, or compare anything. As a soldier he could not afford to "enthuse" over statistics, the bases of which were, to say the least, of uncertain origin.

Mr. W. F. WARD (Government Analyst) considered that Mr. Johnston's paper could not fail to convince anyone who would take the trouble to read it carefully that, excluding the deaths of old people, which formed such a large proportion of the deaths, and the old must die, Hobart death-rate was lower than that of other Australasian cities. But even this was not sufficient to attract the attention of visitors, and so he suggested that the monthly statements might either be so modified as to emphasise every time the high rate from old age alone occurred, or that the vital statistics be published at longer intervals, with full details. The question, however, was not, he thought, so much one of figures as of the general health reputation of the place, and in this we had suffered somewhat, owing, in the first place, to a few conspicuous cases of diphtheria last summer, and in the second, to perhaps a greater degree, to a statement repeated again and again that the town smelt to quite an unusual extent; that bad odours were in fact "frequent and painful and free," the cause being the want of rain to wash the town. Now, the ordinary passer-by did not stop to investigate, but classed everything which offended his or her nostrils comprehensively as "drains," declaimed accordingly, and anticipated germs, although it might be no more than the powerful but harmless water in which a cabbage had been boiled. Yet the good name of the city suffered. There was no necessary connection between bad smells and infectious diseases. Human beings could often, for long periods, eat, drink, and breathe more or less filth, and be apparently not much the worse until the specific germs are somehow introduced which then increase, multiply, and spread in the congenial soil, so that typhoid and diphtheria were known as "filth diseases." It followed, therefore, that though offensive odours might in some cases be practically harmless, yet there was no reason why they should be tolerated if they could by any possibility be got rid of, and if enthusiasts had occasionally exaggerated their effects as well as the death-rate, yet enthusiasm carried most reforms, and had in this case great, if not full, justification.

Mr. JOHNSTON, in replying on the discussion, said he was glad that the main object of his paper had been accomplished. It was his endeavour to show the distinction between the sanitation of a place and its healthfulness; that it did not necessarily follow that while the sanitary

conditions were not as complete as they might be, therefore its health was bad, for during a time being a city might be in a bad state of health, and yet have the best system of sanitation in the world. It seemed to be conceded on all sides that Hobart in the last two or three years had been in a most satisfactory condition as regards its health, but there were differences of opinion as to the causes. He had studied the subject for many years, and still believed that whilst sanitation was valuable in reducing certain diseases, such as typhoid, the great causes of such diseases were still beyond man's control. The percentages had fallen low in some years before any Health Acts were passed, although he admitted that in England typhoid fever cases had of late years been greatly reduced. Too little credit seemed to be given to the increased knowledge of medical men in the treatment of such diseases, and the improved habits of the people. He agreed with Mr. Mault that sanitary agencies were powerful influences in reducing the number of fever cases, but they were not the only ones, and they did not produce such good results as one should like to see. As to what Major General Tottenham had said about the returns supplied to and used by statisticians not being reliable, the objection cut the ground from the objector's own feet, as he had quoted such statistics himself. He would, however, be sorry if the effect of his paper would be that decreased attention would be given in Hobart or anywhere else to the importance of sanitation.

Mr. C. E. BEDDOME read a paper on a new variety of a *Voluta fusiformis* (Swainson), *Var. micro papillosa*, accompanied by drawings of the shells made by Mr. W. L. May, of Sandford.

Two papers, prepared by Mrs. Kenyon, of Melbourne, were read by the secretary, one on "Some Conchological Notes on Tasmanian Mollusca," and the other, "Notes on the Effects of the Atmosphere on the Shells of the Mollusca."

The meeting then terminated with the usual vote of thanks.

MONDAY, AUGUST 10, 1896.

The Chief Justice (Sir Lambert Dobson) presided at the monthly meeting of the Royal Society of Tasmania on Monday evening, August 10th.

The SECRETARY (Mr. Alex. Morton) read a letter from His Excellency's Private Secretary, expressing the regret of the Governor at his inability to preside. Apologies were received from Sir James Agnew and Mr. James Barnard (Vice-Presidents).

The following were elected Fellows of the Society :—Messrs. C. W. Butler, F. Lodge, B.A., and J. H. Levings.

Tuberculosis : (a) Cause, (b) Mode of Infection, (c) Prevention ; (1) by the Individual, (2) by the State ; by Gregory Sprott, M.D., D.P.H., Health Officer for the City of Hobart.

Dr. SPROTT said :—Tuberculosis is a specific infectious disease caused by the bacillus tuberculosis. It is common to man and the lower animals. In the human subject it appears in different forms—such as phthisis pulmonalis, tabes mesenterica tubercular meningitis, scrofula, lupus, etc., but these are all casually related to the bacillus of Koch. It has recently been artificially produced in fish. It may be said to be the most widespread disease we have in domesticated animals, though somewhat rare in their wild state. There is no longer any doubt about the bacteriological identity of all these forms of tuberculosis in the different animals it affects, except, perhaps, in the case of fowls. Wherever man goes we find tuberculosis, and where human beings are most crowded together there the mortality is highest. No country is free from it. In many parts of the vast space of Africa, as in the upper part of the Nile, it is almost unknown. With its distribution climate would seem to have very little to do, but some observers hold it is more severe and rapid in tropical than in temperate regions. All are agreed, however, that a moist, damp atmosphere is decidedly favourable to its prevalence. How this acts is not yet determined. Certain seasons of the year have some influence over the prevalence. In Australia the maximum occurs at different seasons in the various colonies. In Tasmania it is October to December. No race of people are exempt, but the Jews seem to enjoy a relative immunity. Females are said to be more subject to tuberculosis than males, but this varies slightly in different colonies and countries. Tuberculosis is common among infants, and it is estimated that one-fourth of all children dying die of abdominal consumption. In England alone 70,000 deaths occur on an average every year ; 50,000 of these being due to consumption of lungs, and the other 20,000 from other forms of tuberculosis. In Australasia for the three years 1890, 1891, and 1892 the total number of deaths from phthisis alone was 12,243, out of a total number of deaths of 153,069, being about 8 per cent. of all causes. Queensland and Victoria contribute about 9 per cent., while Tasmania and Western Australia contribute only about 6 per cent. With the exception of Western Australia, Tasmania has the best record of all the colonies. If you add the other forms of tubercular disease to this 12,000, you will get a total, say, of 20,000 in three years, which means over 6,000 lost to the colonies every year. What an enormous saving of life it would be to the colonies, as well as to Britain, if we could only prevent this disease in its many forms ! Tubercular matter taken from the lungs of persons buried for years has been found virulent on inoculation. The modes of entrance by which the infecting bacillus may gain entrance into the body are :—(1) By the respiratory and (2) alimentary tract ; (3) by inoculation. (4) Another mode of infection—hereditary transmission—was to be considered. The channel of infec-

tion often determines the seat of the disease. The bacillus, or spores, that dry up and lie about are often inhaled into the body. The sputum of tubercular persons usually furnishes the richest supply of bacilli and their spores, and is often very virulent. Ransome and Williams have been able to demonstrate the bacillus from air collected in the ventilating shaft of the Brompton Consumptive Hospital, and inoculation experiments from the dust collected on the floor of this hospital have proved the infection to be present in the form of spores when the microscope had failed to show the bacillus. Klein kept some guinea pigs on the ventilating shaft, and they contracted the disease also. Then the spores may be communicated by the breath of the patient. Infection by the alimentary canal is, perhaps, the second important mode of infection, and the disease in this way may be communicated by means of milk or meat from diseased animals. Doubt no longer exists about milk from tubercular cows being the means of conveying tuberculosis, particularly to infants and young children. It is now considered inadvisable for consumptive mothers to suckle their infants, for although tubercular disease of the mammary gland is somewhat rare in the human subject, it would seem that the infection may be conveyed without this organ being diseased. The danger of contracting tuberculosis from meat is not so great as the taking of milk from tuberculous cows, but it is nevertheless a source of infection if meat is not properly cooked. When the disease is localised it is thought by some that there is little risk of eating the part of the carcase unaffected, but Professor McCall, of Glasgow, has shown that the bacilli, although not having their habitat in the blood, have been found there as well as in the marrow of bones. The authorities in Glasgow, acting on this, condemn the whole carcase. The parts in close proximity to the disease may be contaminated, while the parts at a distance may not. Inoculation is fortunately not a very common mode of infection. It has followed from a cut on the finger with a broken spittoon used by a phthisical patient. Medical men doing *post-mortems*, butchers, and cooks have been infected in the execution of their duties in this way. It is said to have resulted in two cases from tattooing where the saliva of a phthisical patient was used. The question whether tuberculosis can be transmitted from parent to child is one which authorities are divided upon. Many observers hold that the disease cannot be transmitted, but only a predisposition, and heredity to such as Virchow and Frankel only means greater predisposition, but to Klein it means the actual transmission of the disease. It has seldom been found in calves, and rarely in new born infants. While tuberculosis may be transmitted directly from parent to child, there is a very strong consensus of opinion that the form which affects the lungs is never so transmitted. It may then be taken for granted that "consumption is not hereditary, but only a predisposition—what that predisposition is we cannot yet say." Weakness of the constitution sets up a predisposition. Certain conditions, such as dampness of soil, impurity of atmosphere, are important factors. Dr. Buchanan and Sir John Simon have long since proved that "the drying of soil, which has in most cases accompanied the laying of main sewers in the improved towns, has led to the diminution, more or less considerable, of phthisis," and this has been abundantly proved as the result of town improvements. Dampness of soil and seaboard towns are favourable predisposing agents of tubercular disease. It would seem as if the bacilli were there in greatest numbers and most deadly in effects. Localities with dry soils and uniform temperature are least affected. Nothing tends to predispose to tuberculosis so much as a vitiated atmosphere. This is evidenced by the fact that we have consumption most common in large cities; not only so, but in the parts of them where overcrowding and bad ventilation are at a

maximum the mortality is highest. Dr. Russell, of Glasgow, shows not only the effect of overcrowding on the total death rate, but also the great effect it has on the death rate from consumption. But there are other impurities which tell on the mortality of phthisis besides those from organic vapours, namely, those from trades of different kinds, such as of knifegrinders, weavers, etc. All trades which give rise to dust predispose, and particularly where metallic dust is floating about, to phthisis. Of other predisposing causes might be mentioned improper food, in the case of infants specially, alcohol in excess, debilitating disease of any kind. In brief, it may be said that whatever reduces the vitality or resisting power of the body increases the susceptibility of the individual to tuberculosis. The lecturer then showed how prevention was effected, by diminishing the sources of infection—through the air, milk, and meat—preventing the spread of the bacilli outside the body, and by increasing the resisting power of those who are most exposed to danger. Consumptives should only spit in proper receptacles that have been infected. They should be strongly warned against spitting on cesspits, floors of workrooms, offices, and streets. Expectoration from all phthisical patients ought to be burned. Consumption does not spread through the virulence of its infecting agent, but rather because people are ignorant of its cause and mode of extension. Should the consumptive patient die, or be removed, the room and everything in it ought to be disinfected. Curtains, bedding, and clothing should be boiled, blankets steamed, and all other furniture cleaned and disinfected. Paper on the walls should be stripped off and burned, and the walls washed with chlorinated lime. Many argue that it must come under the compulsory notification Disease Act, and be treated as any other of the infectious diseases. I confess this appeals very strongly to one, but there are many difficulties in the way of notification. For instance, we know that many consumptives are continually changing their residence, and oftentimes, in the hope of being cured, their medical attendant. Are we then to have a report from each medical attendant, and will the patients be required to notify any change of residence? In New York it is subject to inspection, and inspectors are sent, unless requested by the doctor attending not to do so, to instruct patients and their families how to guard against the spread of the disease, to disinfect all premises either vacated by removal or by death of patients without any charge to owner. Boiling milk will get rid of any danger, and it is a good rule to boil all milk, as it will destroy the germs of other diseases as well as of tuberculosis. The sale of milk from infected cows should be rigidly prevented. There should be a rigid inspection of all beasts sold, under skilled supervision, before and after slaughter. The lecturer concluded by alluding to how indiscreet marriages perpetuate the disease; that special care of infants affected the physical development of youth, and the necessity to do everything that tends to strengthen the constitution. Choice of profession to those predisposed to consumption was important; and exercise in the open air was of great value, provided it was not carried to excess. Clothing should be warm and light; diet plain and nutritious, regular meals; alcohol should be avoided as a general rule; and in the choice of a healthy site for residence, high elevations above sea level were advantageous. Tuberculosis (or consumption) was not only a preventable but a curable disease, and the agents which prevent go far towards curing. He was hopeful that a specific serum would yet be found, and that instead of tuberculosis exterminating the human race, the human race would exterminate it.

Dr. BRIGHT characterised the paper as a most able one. He agreed with almost everything Dr. Sprott had said, and did not know he had ever heard a paper calculated to be of better service to the community

read at this society's rooms. He (the speaker) had been of opinion for 25 years that consumption was infectious. He had seen husbands taking it from wives, and wives from husbands, and he had always advised that a consumptive patient should occupy a separate room. Boiling the milk was most important. Dr. F. Swarbeck Hall strongly advised it in this city years ago. Much could be done by the efficient inspection of dairies and dairy cows. They had seen last summer what great dangers the health of the city was exposed to through bad and unwholesome milk being sold. The spread of infection by the sputum of diseased persons was a most serious thing. He believed very strongly that the disease was hereditary; that predisposition was not all that was communicated from parent to child. Tuberculosis was most common in aged milch cows. He moved a vote of thanks to Dr. Sprott, and hoped that the people would boil their milk, also that expectoration about the streets would be suppressed.

Dr. HARVEY seconded, and congratulated Dr. Sprott on the able way in which he had handled the subject. Another means of prevention was undoubtedly to be found in a reform in the manner of burying the dead. Spores of disease were often brought up by the earthworm.

Dr. CROSBY WALCH believed that the disease was not hereditary, but predisposition only was communicated from mother to child.

Mr. MAULT intimated that the Central Board of Health was seeking to obtain legislative power to inspect all dairies in the country sending milk into the city.

The CHIEF JUSTICE thought, that if it be true that there was no tuberculosis in Tasmanian cattle, as Dr. Sprott had indicated, the colony must have a great advantage, and with the use of the tuberculin test in examining all stock brought to the colony for slaughter it might be kept out of our cattle and our meat.

The vote of thanks was passed with acclamation.

Dr. SPROTT, in replying, said it was generally conceded that consumption of the lungs was not hereditary, but tuberculosis was hereditary. So long as a person kept strong and in good health, the bacilli of tuberculosis need not be feared. As to tuberculosis in stock in Tasmania, he had stated that he had not, so far, been able to find any.

ROUTES TO THE WEST.

Mr. J. B. WALKER, F.R.G.S., read a paper, prepared by Mr. T. Stephens, M.A., F.G.S., upon "Land Routes to the Western Districts," illustrated by an enlarged map. The writer first dwelt on the natural obstacles, notwithstanding that there were no savages or man-eating tigers to be encountered. Having referred to past surveys and proposed railway routes, he described the land routes along which tracks should be made. He first referred to the Linda track from Mole Creek. Another was from Sheffield to Mount Read, a distance of only 50 miles, one half of which is already covered with tracks fit for horse or foot traffic. The Marlborough and Mount Atrowsmith to Mount Lyell route was next referred to, and which it was claimed should be kept open. Then there was the route known as "Dawson's road." It was now evident that a more direct route to the Gordon was obtainable south of Mount Field. Two other routes were noticed, one passing the head of the Florentine Valley and striking out to Mount Lyell, and the other going from the head of the Florentine Valley to the Gordon. He thought a much easier way could be found south of

Mount Wedge and *via* Lake Pedder, but in the interests of mining exploration that would not be advisable. He commended very strongly the preliminary work of exploiting tracks, but the whole area should be well explored before there was any proposal for a railway.

Discussion on the paper was postponed.

OTHER PAPERS.

The Question of Land Routes from Eastern to Western Tasmania, by Thos. Stephens, M.A., F.G.S. Notes on the Nidification of the Black Cockatoo, and Description of some New and Rare Fish, *Lampris luna* and *Antennarius mitchelli*, by Alex. Morton. Classified list of the Tasmanian Minerals, by W. F. Petterd, F.Z.S.

COMET PHENOMENA.

Mr. Water F. Gale, Fellow of the Royal Astronomical Society of London, on a visit to the colony, with the aid of a lantern manipulated by Mr. Nat Oldham, gave a most interesting description of some comet phenomena, and was accorded a vote of thanks, after which the proceedings terminated.

MONDAY, SEPTEMBER 21, 1896.

Mr. Bernard Shaw presided at the monthly meeting of the Royal Society of Tasmania on Monday, September 21st, and there was a good attendance. The subject for discussion was the West Coast routes, introduced at the previous meeting by Mr. T. Stephens.

NEW MEMBERS AND VISITORS.

Mr. Robert Sticht, metallurgist, Mount Lyell; Dr. E. T. MacGowan and Mr. R. Fitzarthur Waller were elected. Also Major C. M. Officer, F.G.S. (London), and Mr. W. H. Palmer, C.E., two visitors.

WEST COAST TRACKS.

The discussion on this subject was resumed.

Mr. T. STEPHENS said: As the report of the second party despatched to explore the country lying to the west of the Mount Field Range had now been received he might, by way of postscript, add a few words to the paper read at the last meeting. The work of the recent expedition, which was undertaken under conditions of exceptional hardship and difficulty, had not done much towards the exploration of the particular tract of country to which he had directed attention; but it had shown that there are obstacles to a route along the River Gordon, which, though they should not be regarded as insurmountable, would necessitate a considerable expenditure of time and money before a practicable track could be opened in that direction. He had, therefore, indicated upon the chart an alternative route. Taking the Humboldt Divide and the country about Mount Lyell as the two extreme points, this route should be carried westerly to some point between the junction of the Serpentine on the south and the Denison on the north side of the Gordon, where a convenient crossing place can be found on the last-named river. There a depôt should be provided. An opportunity would thus be given for examining both banks of the Gordon towards Macquarie Harbour, but the main object should be to push through the unexplored country between the Rivers Franklin and Denison to the Linda track, and thus make accessible that large area which is still described on our latest maps as "unexplored."

Mr. E. A. COUNSEL (Surveyor-General) said Mr. Stephens had dealt very fully with the country being opened up from Glenora, and he (Mr. Counsel) would deal with the subject under three headings, namely, (1) the results following track cutting into unexplored country, showing how districts had been opened up on the lines of those in various parts of Tasmania; (2) the conditions under which the work might be undertaken; (3) future exploration. Under the first heading the speaker made out a forcible argument for continuing the making of these tracks in the unexplored parts of the West Coast. As to the Mole Creek route spoken of by Mr. Stephens, with branches, they must be fairly tested before a definite course as to them was taken. They would no doubt serve very important districts, but the danger was of their being at too high a level for winter traffic. Strange to say, the Gordon and Rasselas route was still undetermined, notwithstanding the fact that the country intended to thereby so open up (as well as to provide communication to the West Coast) was almost accessible by a main-road (Dawson's road) as far back as 1860; and notwithstanding the fact that actual surveys and settlements were made as far west as the base of Frenchman's Cap in 1853. At that date a block was actually leased at the base of Frenchman's Cap. The Rasselas Valley route would no doubt be improved as the examination of the country progressed. As to the Tyenna route, explored by Mr. Innes who

reported that a route between Mount Humboldt and the navigable part of the Gordon was impracticable, that applied to the south side of the river, the connection being blocked by the Franklin and Wilnot ranges, which attained a maximum height of 3,245ft. above sea level; but Mr. Innes believed it was possible to obtain a passable track by keeping to the south of Mount Wedge, passing through the Huon plains, and round the south end of the Franklin range, bearing thence to the lower Gordon. This route was not looked upon with favour generally, though it would have its advantages. Much of the criticism on Mr. Innes' action had been made without due consideration of the difficulties he had to encounter. The Government had undertaken to explore both the Gordon and Rasselas routes during the summer, as far as tracks were concerned, and that should afford satisfaction to those interested. It was an interesting question whether the track south of Mount Wedge, suggested by Mr. Innes, should be made open to traffic, and so bring the Huon district in connection with the West Coast. The cutting of tracks in the manner indicated would not cost very much, and was exceedingly desirable. He next referred to routes north of the Gordon and Gould's explorations and routes, which went through mineral country.

Hon. B. S. BIRD approved of the suggestion made that the country unexplored should be opened by tracks of some kind not for trade only, but what was even more important, for prospectors to traverse, for after them would come trade. He expected to see Port Davey yet made the main port of the West Coast. It would be a grand natural harbour with railway communication between the metropolis and the West Coast.

Mr. HOWARD WRIGHT thought that one wise course would be to open up the upper Dawson's-road from the Florentine, which would take prospectors to the Gordon Bend. There was no reason why traffic should not be facilitated to pass that way in a month or two, and with stores at Huntley. He thought it would be better than wasting money over a track from Tyenna to the head waters of the Gordon.

Mr. R. M. JOHNSTON explained his reasons for favouring a Huon route. He agreed with Mr. Wright that bases of operations would have to be established. He believed there was a great area of country yet unexplored which was highly auriferous.

Mr. PALMER, C.E. (Victoria), who had recently come through to Hobart from Lyell by the Linda route, strongly recommended the establishment of depôts along a route as it was being cut. As to a railway, there were no serious engineering difficulties. There would be no extreme grades. The greatest difficulty was to get through the timber. The greater engineering difficulties could easily be got over by an electric railway. Grades inaccessible by ordinary locomotives were easily surmounted by electric trains with very considerable power. This had been amply proved on the Canadian Pacific Railway where it crossed the Rocky Mountains. There the locomotive train was left, and an electrical train substituted for 34 miles. The greatest engineering difficulty would be at a point near West Mount Field, where there was a very steep gradient. The country possessed any quantity of water power. That was one great advantage in the whole region. If a million horse power were required it could be got.

Hon. HENRY DOBSON dwelt on the importance of providing the West Coast routes to Hobart in a thoroughly practical but inexpensive manner. He did not quite agree with Mr. Bird that a route *via* Huonville was the best. It must go north of Huonville. Every pound spent in this way, so far, had been justified by enormous developments. He advocated the formation of a Council of Mines to act independently of party.

Major OFFICER spoke of the enormous value the cutting of tracks had been in Victoria. It was the duty of the Government, and the duty of the people to urge the Government to cut tracks wherever found desirable. He spoke of the extent to which the trade of the West Coast, which should come to Hobart, was going to Victoria, and that could only be diverted by a railway.

The reading of Mr. Rodway's paper on fungi was postponed, owing to the lateness of the hour at which the above discussion closed.

The meeting then terminated with votes of thanks to Mr. Stephens, Mr. Counsel, and the chairman.

TUESDAY, OCTOBER 13, 1896.

The Chief Justice (Sir Lambert Dobson) presided at the monthly meeting of the Royal Society of Tasmania.

The SECRETARY (Mr. Alex. Morton) read letters of apology from Sir James Agnew, Hon. C. H. Grant, Messrs. J. Barnard, J. B. Walker, and R. M. Johnston.

DEATH OF BARON FERD. VON MUELLER.

In taking the chair, Sir LAMBERT DOBSON said : In the last few hours death had claimed one whose name had stood amongst the foremost of the scientific botanists of the world. Baron Ferdinand Von Mueller had passed away, and it was fitting that on this first occasion of the meeting of the Society they should give expression to the deep regret the members felt at the loss that the scientific world, and Australia especially, had sustained in that sad event; and also to give expression to the high esteem and admiration in which they held the Baron. He was one who commenced life as a practical botanist. He took part in various explorations in Australia, and very rapidly gained for himself a name, and one which, with advancing years, became better known and more respected in the scientific world, till towards the end it might be questioned whether any living botanist stood higher than the learned Baron. This Society owed him a very deep debt of gratitude for all he had done for it. From his earliest days in Victoria—the fifties—he constantly supplied contributions to this society, and whenever they had been at a loss on any botanical question or subject, he was ever ready to give them the advantage of his great knowledge, and that, too, in an unselfish and ungrudging spirit. Baron Von Mueller was one of those scientists who looked upon what he knew as not his own, but obtained for others. The humblest student of botany had but to apply to him to find that the great fountain of knowledge he possessed was ever ready to be poured forth for the benefit of anyone seeking to taste of the springs of botanical knowledge. As early as May, 1858, his eminent services in the science of botany in Australia were very greatly appreciated, and in consequence of the aid he afforded to the Tasmanian Royal Society, it was proposed to make him a corresponding member, and he was accordingly elected unanimously. The meeting of the Council at which he was proposed was attended by eight members. Of those all but our venerable Vice-President, Sir James Agnew, had passed away. He would mention their names—Messrs. Joseph Hone (vice-president), in the chair; Hon. W. Henty, Hon. J. Walker, Alderman Lipscomb, Thos. Giblin, J. W. Agnew (now Sir James W. Agnew), James Sprent, Morton Allport, and Dr. J. Milligan. On September 5, 1882, this Society elected him as an hon. member. They missed the name of two or three of the members of the Council of even that time. Messrs. Jno. Swan, C. T. Belstead, H. J. Buckland, and Justin Browne had gone before him. Fortunately the Baron's work did not expire with him. He had contributed no less than some 20 volumes of botanical scientific information, many of them were illustrated books, and all prepared with the greatest care and diligence. He (Sir Lambert) believed the Society possessed copies of all those works. They afforded a foundation of solid information for any botanist of Australasia to work upon, and he believed the eminent author had assisted Mr. Bentham in his work on Australian flora, and in his great work upon our trees and plants. All this work the Baron had done. He was nominally the botanist of Victoria, but he really had been the botanist of all Australasia. The information he had furnished was valuable alike to all the colonies; he drew no lines, he knew no distinction—from wherever information was sought he was



BARON FERDINAND VON MUELLER.

ready to give it. His name was as familiar as a household word, within the walls of the Society's rooms, and they would long miss him as an authority unquestioned and unquestionable, to whom any botanical matter could be referred. How Baron von Mueller would be replaced it was impossible to say. Good men generally appeared when called for. There was no doubt—and probably through the Baron's example—the science of botany throughout the colonies had taken great strides of late years. The Baron was not only a scientific botanist, but he also brought his knowledge to bear on botany for economic purposes, having introduced for these colonies a large number of plants and fruits of economic value, and others that he had, at any rate proved, were not of economic value. The Baron had now gone, and he (Sir Lambert) was satisfied that throughout the colonies his loss would be recognised and deeply regretted, and his many admirable qualities would be often alluded to in future years. Now the silver cord was broken and the Baron rested in peace.

FUNGI.

MR. L. RODWAY read a paper on fungi in [his usual interesting and instructive style. He said that whilst all other branches of plant life had ample attention paid to them the fungi were neglected because of vast numbers and variety, evanescence, and obscurity, which necessitated a painted copy and microscopical examination. As to the utility of the study, the work done by fungi in breaking down dead tissue was very interesting and instructive. He next dwelt on the destructiveness of various forms of parasitic life on plants, such as rust on wheat and black spot on apples. The study of fungi was, therefore, useful in considering plant diseases and to learn how to cope with the same. The estimated loss from rust in wheat alone in Australia was between two and three millions sterling. In the United States it was 67 million dollars. In India the loss from all fungoid diseases was 10 million pounds per annum, as stated in the *Agricultural Ledger*, published in Calcutta last year. In England alone, while there are about 1,760 flowering plants, there are 4,895 fungi. Tasmania had about 1,000 varieties of flowering plants, and there was little doubt that the fungi in this colony exceeded 1,500. As neither of these countries can be considered peculiarly rich in fungi, and as the number of flowering plants of the world might be roughly estimated at 100,000, some idea of the number and necessary variety of fungi might be conceived. Fungi formed almost a kingdom of themselves. They fed like an animal, but fruited like a plant. They had a very slight link of affinity attaching them to the other plants, whilst through one section, namely, the Mycetozoa, as the name implied, the approach to animals was very marked. The edible qualities of many fungi were not of great importance to the botanist, nor in Tasmania of much consequence to the utilitarian; but in many countries fungi constituted the luxury of the rich, and a staple article of food for the poor. In Tasmania there were many wholesome forms besides the common mushroom. At the same time there were many fungi which were most violently poisonous. He concluded with a graphic description of the luminosity of fungi in Tasmania, and the phenomena of their growth.

Hearty applause greeted the reader of the paper upon resuming his seat.

MR. T. STEPHENS, in the course of some comments on the paper, said they could not but regard Mr. Rodway as *facile princeps*—the

botanist of Tasmania. He congratulated the Society upon that evening returning to consider such subjects as formed the *raison d'être* of its existence. He had observed that rust in wheat was more liable to be present in soils which were deficient in silica.

VOYAGE OF ALVARADO.

Mr. J. R. McClymont, M.A., read a very interesting paper entitled "An Explanation of the Voyage of Alvarado, as narrated by Galvano." The author said that when Cortes had accomplished the conquest, and, what was called euphemistically, the pacification of Mexico, he resolved to despatch an expedition to the Moluccas by a course near to the Equator. Galvano states that Cortes undertook this task in order that the new Viceroy, Mendoza, should not rob him of his honour. When we remember that Cortes had solicited the position of Viceroy in vain, the motive ascribed to Cortes will not appear wholly improbable, although his career, the writer said, was rather that of a man actuated by love of achievement than by mere ordinary ambition. Whatever the motive may have been, it appears certain that immediately after the arrival of Mendoza in Mexico Cortes equipped two ships. The account of this expedition, Mr. McClymont said, were strangely divergent, and could only be made intelligible by supposing that the Spanish historians had followed the fortunes of the ship commanded by Hernendo de Grigalva, whilst the Portuguese historian, Galvano, follows the fortunes of the other ship commanded by one Alvarado, a hidalgo. There can be no doubt, the writer of the paper says, of the authenticity of Galvano's narrative, for he was actually Governor of the Moluccas when Alvarado arrived there, and his veracity and fairness are recorded as celebrated throughout the Portuguese dominions. The writer said it was not necessary to follow the course taken by the ship of Grigalva, because he had recently done so in a paper read before the Society, entitled "Early Voyages to Papua." It was shown that the first destination of the two ships was San Miguel de Tangaraga, in Peru, they having been sent there with reinforcements of Pizarro, in compliance with the request of that general. San Miguel does not appear, the writer said, on modern maps, but it was not far from Payta, in about 6deg. S. lat. Both of these places, it was pointed out, were mentioned as the port of departure of the ships for their great voyage. Galvano makes it San Miguel. Mr. McClymont said there was a discrepancy as to the instructions given to the commanders. Spanish writers say they were to search for certain rich islands supposed to lie to the west, not the Moluccas, for these would, no doubt, have been mentioned by name, or under the name of the "Islands of Spices," had they been intended. This was pointed out what Grigalva understood he had to do. But Alvarado thought he had to sail to the Moluccas, keeping near the Equator. The writer said possibly the jealousy between Cortes and Mendoza explains this difference in the designs of the two commanders. Mendoza, being disappointed that the instructions for the commanders had been taken out of his hands by Cortes, may have persuaded Grigalva to deviate from his instructions, and he may have consented to do so in the hope that he would thereby not only curry favour with the Viceroy, but also gain greater renown and wealth than the mere discovery of a new route to the Moluccas would bring to him. His share, Mr. McClymont said, of the expedition ended in total disaster. Galvano does not, the writer states, give the exact date of departure from Peru. Spanish

writers say April, 1537. It need not surprise us, said Mr. McClymont, if, in this first voyage across the Pacific from a South American port, the distances and the latitudes are uncertain and irreconcilable. There is one matter we may be thankful for, and that is, the attempt to render the names of the islands visited in the vernacular of these islands. This, Mr. McClymont said, was much more satisfactory than dealing with European names of doubtful appropriateness, which give no clue to the modern investigator. It was pointed out that these vernacular names, with one single exception, were not written as we write them now. The writer dealt with several of the Pacific Islands visited by Alvarado. The paper, from a geographical point of view, was a most interesting one, and threw much light on the work done in the 15th and 16th centuries by the early navigators.

DEATH OF SIR JOHN FRANKLIN.

Mr. F. LODGE called attention to a reference in the *Magazine of Art* to an Austrian painter having painted an imaginary scene of the death of Sir John Franklin. He mentioned it in order that inquiry might be made to know if it was possible to obtain prints of the picture.

The SECRETARY said he would make inquiries.

The proceedings then terminated with a vote of thanks to the readers of the papers.

MONDAY, NOVEMBER 16, 1896.

The last monthly evening meeting of the session of the Royal Society of Tasmania was held on Monday evening, when Mr. James Barnard presided, and there was a large attendance. Apologies were read from His Excellency the Governor and Sir James Agnew.

A BATCH OF MEDICOS.

The following medical gentlemen were balloted for and elected members of the Society:—E. J. S. Spark, M.B.; J. E. Wolfhagen, M.B., C.M.; S. C. Jamieson, M.B.; H. G. H. Naylor, L.R.C.S.; R. G. Scott, M.B., C.M.; and R. Wilmot, M.R.C.S., E.

A MEDICAL SECTION.

The SECRETARY (Mr. Alex. Morton) announced that a medical section of the Royal Society had been formed, and Dr. Bright, the first president of the section, would have some remarks to offer upon the subject.

Dr. BRIGHT, on behalf of the medical section just formed, moved a vote of thanks to the Society for the kind and generous manner in which the Society had treated them, giving them every encouragement. The use of the Society's rooms had been promised them for meetings, and like a kind parent, had voted them pocket money as well in the shape of £12 with which to purchase certain standard medical works. The section had started under very favourable auspices with 18 members, some of whom had been elected that evening, and there would be others to follow.

Dr. SPROTT seconded the motion, mentioning that they were also deeply indebted to Mr. Morton, the secretary, for the assistance he was also giving the new medical section. He felt certain that the new section would prove a material advantage, both to the medical men of Hobart and the public.

The CHAIRMAN, on behalf of the members of the Royal Society generally, reciprocated the sentiments expressed in suitable terms.

The SECRETARY mentioned that whilst Dr. Bright had been chosen the first acting-president of the new section, Sir James Agnew was the first honorary president.

VISITORS.

The CHAIRMAN welcomed Mr. Percy Douglas and Mr. W. H. Trewenack, two Sydney gentlemen.

ATMOSPHERIC DISTURBANCES.

Mr. KINGSMILL read a paper on atmospheric disturbances and weather forecasting during the year 1895, carrying forward the information which Mr. Wragge imparted some time ago in a lecture before the Society. He analysed the forecasts sent by Mr. Wragge, showing how successfully they had worked out. He illustrated his remarks by means of maps thrown on the screen by the aid of Mr. Russell Young's lantern. He also read Admiral Fitzroy's commendation of the forecasts, and showed the necessity of these observations in Tasmania.

TERTIARY LEAF BEDS.

Mr. R. M. JOHNSTON gave an interesting account of the discovery of tertiary leaf beds with tin drift in Thureau's deep lead, St. Helen's. Through the kindness of Mr. A. J. Brown, of St. Helen's, Mr. Johnston

stated that he had been put in possession of a very interesting collection of specimens, all of which are replete with more or less perfect impressions of leaves, twigs, etc. The prevailing forms, though fragmentary, are very clearly impressed, and having made a careful examination of their specific character he was now satisfied that two of the forms could be referred to as species already described in similar deposits in New South Wales and Tasmania now assigned to the eocene tertiary age. He then minutely described them with illustrations thrown on the screen, making the subject very interesting.

MOUNT LYELL DISTRICT.

The greatest treat of the evening followed, when Mr. J. W. Beattie, who has just returned from a photographic tour to the West Coast, exhibited a large number of lantern slides illustrating the whole district of Mount Lyell, Penghana, Queenstown, and the magnificent scenery of the King River and Gorge, eliciting frequent applause. The grandeur of the scenery, alternately partaking of Alpine heights and Californian gorges, excited great interest in the audience. In addition to following up the Mount Lyell railway to the company's works, showing the many steep gradients, and the trains climbing the hills on the Abt system, Mr. Beattie presented views of the works themselves, the quarries, and mines. He also seemed to have obtained a very good notion of the various processes which the ore goes through from the mine to the converter; and what with these explanations and various photographic pictures of the interior of the works, he was able to impart much very instructive information.

Mr. R. M. JOHNSTON remarked that Mr. Beattie had done another piece of good service for Taamania by the production of such magnificent photographs. The speaker then had thrown on the screen some statistical tables showing how the mining interest was advancing in the colony. For the year 1895-6 the output of mineral wealth was £745,996.

VOTES OF THANKS.

The meeting then terminated with the usual votes of thanks, the CHAIRMAN remarking that much of the success of the session now closing had been due to the zeal and energy of their indefatigable secretary—Mr. Morton. In moving a vote of thanks to the Chairman, the Hon. Abye Douglas, M.L.C., referred in complimentary terms to the good service Mr. James Barnard had rendered the Society since his election as far back as 1841.

List of additions to the Library of the Royal Society of Tasmania :

BOUND VOLUMES.

Annual Report of the American Historical Association, 1894, containing report of proceedings of 10th annual meeting in Washington, D.C., December 26, 1893, by H. B. Adams, secretary. The Tendency of History, by Henry Adams, president of the Association. Rise of Imperial Federalism (abstract), by Professor G. P. Adams. The Historical work of Professor H. Tuttle. Turning Points in the Civil War, by Dr. R. Johnson. Tributes to Hamilton Fish, Hons. J. Hay, R. G. Winthrop, and others, by General James Grant Wilson. The Tejas: Their habits, government, and superstitions, by Mrs. L. C. Harby. Why Coronado went to New Mexico in 1540, by P. G. Winship. The Casade Contratacion of Seville, by Professor B. Moses. Some European Modification of the Jury System, by D. W. B. Scaife. The Regulators of North Carolina (1765-1771), by Professor J. S. Bassett. A Chapter in the Life of Charles Robinson, the First Governor of Kansas, by Professor F. W. Blackman. The Continental Congress, by Dr. H. Friedenwald. The Labour Movement in English Politics, by E. Porritt. The Organisation of the First Committee of Public Safety, by Professor H. E. Bowne. The Quebec Act and the American Revolution, by V. Coffin. The Historical Archives of the States Department, by A. H. Allen. Appeals from Colonial Courts to the King-in-Council, with special reference to Rhode Island, by H. H. Hazeltine. Rhode Island, and the Impost of 1781, by T. G. Bates. The Constitutional Controversy in Rhode Island in 1841, by A. M. Mowry. Party Struggles over the Pennsylvania Constitution, by S. B. Hardiug. Evolution of Township Government in Ohio, by J. A. Wilgus. The Western Posts and the British Debts, by Professor A. C. McLaughlin. Existing Autographs of Christopher Columbus, by W. E. Curtis. Mountains and History, by Professor E. K. Alden. Causes and Consequences of the Party Revolution of 1800, by Professor J. H. Robinson. What the United States Government has done for History? by A. Howard Clark. Bibliography of the Colonial History of South Carolina, by E. L. Whitney, Washington, 1895. From the Society.

Bureau of Ethnology, thirteenth annual report of the Smithsonian Institution, 1891-2. By J. W. Powell, director, Washington, 1896. From the Department.

Catalogue of books in the Pedagogical Section of the University Library (revised edition). Addresses at the Inauguration of Martin Kellogg, LL.D., as President of the University of California. Berkeley, March 23, 1893. From the Department.

Determinacao das Posicoes Geographicas de Kodeio, Entre-rios Juiz de Fora, Joao Gomeze Barbacena. Le Climat de Rio de Janeiro. By L. Cruls, Director de Observatorio de Rio de Janeiro. From the Department.

Guide to the Literature of Æsthetics. By Charles Mills Gayley, Professor of the English Language and Literature in the University of California, and F. Newton Scott. Ph.D., Assistant Professor of English in the University of Michigan. Berkeley, 1890. From the Department.

Missouri Geological Survey, Vol. IV., V. Palæontology of Missouri. Parts 1 and 2. By C. R. Keyes, A.M., Ph.D., State Geologist. Vols. VI., VII. Lead and Zinc Deposits. Sections I. and II. By A. Winslow, assisted by J. D. Robertson. From the Department.

Observatoire de Rio de Janeiro Methode Graphique, pour la determination des heures approchees des eclipses du soleil et des occultations par. L. Cruls, Director de l'Observatoire, Rio de Janeiro, 1894. From the Department.

Proceedings of the Royal Colonial Institute, Vol. XXVII., 1895-96, London, 1896. From the Institute.

Rainfall in India, third year, 1894, Calcutta, 1895. From the Meteorological Department.

Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-6, Vols. 1 to 50, London, 1885. From the British Government.

Smithsonian Report of the U.S. National Museum under the direction of the Smithsonian Institute for the year ending June 30, 1893. Washington, 1895. Proceedings of the United States National Museum, Vol. XVII., 1894. From the Smithsonian Institution.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. XXXVIII., 1894-95. Glasgow, 1895. From the Institution.

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I., Report of Director. Part II., Accompanying Papers. From the Department.

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Addresses at the Inauguration of W. T. Reid as President of the University of California, and the dedication of the Bacon Art and Library Building, Berkeley, August 23, 1891. Sacramento, 1891. From the Department.

Addresses at the inauguration of Horace Davis as President of the University of California. Berkeley, March 23, 1888. Sacramento. From the Department.

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Amblychila, the species of. By J. J. Rivers. From the Society.

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Anales de la Oficina Meteorologica Argentina por su Director G. G. Davis. Tomo X. Buenos Aires, 1896. From the Department.

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Authentic Letters of Columbus. By W. E. Curtis, Hon. Curator Department of Columbus Memorial Chicago. May, 1895. Vol. 1, No. 2. From the Trustees Field Columbian Museum.

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American Palæontology, 1888-1892, Keyes, No. 122. Results of Primary Triangulation, Gannett. From the Department.

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THE HEALTH OF HOBART.

BY

R. M. JOHNSTON, F.L.S.

(Read 28th May, 1896.)

DURING the years 1887, 1888, 1889, and 1891, the City of Hobart, in common with the principal cities of Australia, was visited by a most severe and extraordinary epidemic wave of typhoid fever. Although, locally, the general death-rate from all causes, and for all ages, was not materially increased above the years preceding the epidemic, still the mortality of persons in the prime of life, especially males between the ages of 20 and 35 years, was unusually large. The alarm caused by this severe visitation very naturally raised a keen enquiry into the sanitary condition of the city; and many intelligent persons, believing that the epidemic was mainly or solely due to local causes, and particularly to defective drainage and other imperfect sanitary provisions, have since made vigorous and continuous demands for a drastic reform of our sanitary system. To aid in this praiseworthy endeavour, statistical comparisons with other Australian cities are by such persons frequently placed before the people with the object of showing that, but for our defective system of sanitation, the typhoid epidemic would not have appeared, or that its intensity, at least, would have been very much reduced. During the last three years, fortunately, the city has been free from typhoid in the epidemic form, and the death-rate from this and all other preventible causes have never been so low. Whatever may be the cause or combination of causes which, during the last three years, have raised the City of Hobart into a healthier state than that of any other period of its history, and have constituted it pre-eminently as among the healthiest cities of the world, it is obvious that local, artificial, or sanitary provisions have had very little to do with it, for a similar fall in preventible causes of death, if not so great, is distinctly traceable throughout Australia and Tasmania, generally during the same period, as shown in the following table :—

DEATH-RATES (1884-95), in Four Australasian Capitals, from all Causes, and from Preventible Causes alone.
(Per 1000 Persons living.)

	TOTAL DEATH RATE. All Causes.				DEATH RATE. From Preventible Causes.*			
	Hobart.†	Sydney.‡	Melbourne.‡	Adelaide.§	Hobart.	Sydney.	Melbourne.	Adelaide.
1884	23·47	22·31	20·54	28·55	17·19	21·95	20·07	...
1885	24·15	23·20	20·15	23·84	18·93	23·84	19·56	...
1886	22·58	21·26	20·42	23·67	17·73	20·96	19·90	...
1887	24·41	17·85	21·25	23·15	19·03	17·16	20·69	...
1888	21·38	19·14	20·51	22·69	17·35	18·42	19·97	...
1889	20·54	18·39	23·38	21·41	16·63	17·64	22·84	...
1890	19·98	15·39	19·63	23·05	15·74	14·78	19·10	...
1891	22·67	16·48	19·05	24·57	17·49	16·01	18·60	22·20
1892	20·97	13·56	15·99	20·77	16·70	13·20	15·63	19·17
1893	20·27	15·57	17·07	24·86	16·45	15·23	16·61	23·14
1894	16·95	14·12	15·55	19·47	13·49	13·63	15·07	18·00
1895	14·90	13·19	15·97	14·86	11·84	12·81	15·49	13·39
Mean 1884-93	22·04	18·31	19·80	23·63	17·42	17·92	19·30	21·50¶
Mean 1894-5	15·92	13·65	15·76	17·16	12·66	13·22	15·28	15·70
Per cent. Decrease.....	27·76	25·46	20·41	27·38	27·32	26·23	20·83	26·97

* Deaths from preventible causes include deaths from all causes save deaths from "senile decay" or "old age." † Corrected for deaths occurring in Hospital, and from causes which originated outside the Registration Districts. ‡ Includes suburbs. § City only. ¶ Mean of Years 1891-93.

Enthusiasts for reform or improvement of our local sanitary system, unfortunately, like all enthusiasts, are ever prone to exaggeration, and many of them still continue to speak of the local sanitary condition and health as unexceptionally bad, and in both respects inferior to other Australian cities. These incorrect and unguarded statements have produced much alarm locally among the naturally timid, and have done much harm to the reputation of the city as a health resort by scaring away visitors from other Colonies.

The protest from our Premier, Sir Edward Braddon, against these inaccurate alarmist statements will, it is hoped, help to repress them, and draw attention to the fact already stated—viz., that during the last three years the city has never been in such a healthy condition, and that it now stands pre-eminently one of the healthiest cities in the world.

HEALTH STATISTICS.

Although it is difficult to account for it, it is not the less true, that mistrust of statistics is very general. On all hands one hears the remark “You can prove anything by figures.” “Figures can be made to lie.” But a similar retort can more justly be made to apply to all worded statements or arguments. The true and sufficient reply to this taunt is, “Without accurate statistics or measures, you can know, compare, or prove nothing.”

It is true that statistics are likely to be misinterpreted or mishandled by persons who lack the necessary knowledge of the subject to which they relate, or who lack training in statistical science. Almost everyone, however, thinks that he can understand figures, and easily read their true meaning. But the mere mathematical or arithmetical side of statistics, paradoxical as it may appear, plays a minor part in the statistical investigation of any subject. As Longstaff, the eminent statistician, well observes, “The primary requisite is a logical mind and a sound logical training; the second (and not less important) is a good general knowledge of the subject to which the figures under consideration relate. Only a chemist is likely to derive information from a new chemical experiment; in like manner the statistician must be now a banker, now a farmer, now a merchant, now a doctor, according as he is

manipulating figures relating to currency, crops, tariffs, or causes of death." Even then, in comparisons between different countries, he must be in possession of a good up-to-date library of statistical reference, and be able by experience to determine readily good from bad authority, and have a wide knowledge of the best sources of information. The knowledge and exact signification of the current statistical terms are all essential; for not a little confusion and conflicting opinion arise from misinterpretation of the true significance of terms in common use among statisticians. As the demonstration and acceptance of the truth of the statements made by me regarding the present healthy condition of Hobart largely depend upon clearly understanding the difference between a "Total Death Rate" and a "Health Standard Rate"; in discerning and separating preventible causes of death from the non-preventible; and in marking the difference, proportion, and effect which in age and sex determine a General Death Rate—quite apart from any consideration of health,—it is necessary at the outset that such preliminary remarks as have been made should be carefully weighed, and that a few simple illustrations should be given to enable the uninitiated to comprehend the difficulties of statistical comparison between different periods and different places, without which a true estimate cannot be formed of the comparative healthiness of different cities. No two cities, or two periods in the same place exactly, agree in the age or sex combination of their respective populations; but, such is the remarkable influence of these factors in the actual determination of a general death-rate that, unless such differences are strictly determined and allowed for, it is as likely as not that the healthiest period or the healthier place would be placed erroneously in the worst position, while the least healthy period or the least healthy city might appear erroneously in the best.

The following illustration of the disturbing effect of great disproportion of numbers at different ages is taken from the two divisions of the Registration District of Hobart for the year 1894:—

YEAR 1894.

	Hobart City.	Hobart Suburbs.	Both.
Per cent. proportion of persons living :			
0-5 years	12·83	12·92	12·85
5-65 years ..	82·87	78·06	81·64
65 years and over.....	4·30	9·02	5·51
Per cent. proportion of deaths :			
0-5 years	28·87	11·27	23·23
5-65 years	45·95	25·98	39·55
65 years and over	25·18	62·75	37·22
Deaths per 1000 persons living at each age group :			
0-5 years	36·79	19·59	32·38
5-65 years	9·07	7·46	8·67
65 years and over	95·70	156·10	120·95
Total Death Rate for all ages without allowing correction for disproportion in age groups.....	16·36	22·44	17·91
Health Standards {	Death Rate for all ages corrected for age disproportion	17·10	16·63
	Death Rate for ages under 65 years corrected for age dis- proportion	21·79	9·19
		11·90	

The preceding table affords one of the best illustrations of the misleading effect of taking the Total Death Rate for All Ages as a Comparative Health Standard between places or times when there is any material difference in the proportion of people living at the principal age groups whose normal death-rates differ so widely. In "The Tasmanian Official Record, 1892," pp. 208-220 it has been clearly demonstrated "that the ordinary reference of the proportion of total deaths to the number of persons living is not *in itself* in any sense a *Comparative Health Standard* as popularly understood; and that all comparative methods which ignore proportional age-groups living, and make no allowance for the value of longevity, are utterly misleading in most cases when unguardedly used as comparative standards of health." In a communication to the Royal Society of Tasmania in the year

1887, a simple method was introduced by me for correcting the misleading total death-rate for all ages where living age-groups in different places or times differ in proportion with each other respectively. This method has the effect of converting the ordinary death-rate into a most effective Comparative Health Standard, and has received the commendation of our leading authorities in vital statistics, and has since been widely adopted.

The method referred to divides the ages living into three principal groups—0-5, 5-65, 65 and over; and as it has been ascertained by reference to the average numbers living in different countries that these groups constantly bear the proportion to each other of 3, 18, 1, nearly, these simple numbers were selected as the best and most convenient for converting the ordinary misleading death-rate for All Ages into a most effective and truthful Health Standard.

The method for effecting this correction as used in the preceding table of comparison was illustrated as follows:—

Let A = Proportion of ages living 0 — 5 years = 3
 B = " " 5 — 65 " = 18
 C = " " 65 and over = 1
 R^a = Death-rate actually yielded by ages living 0—5
 R^b = " " " 5 — 65
 R^c = " " " 65 and over
 D = Relative or Comparative Health Standard for all ages.

$$\text{Then } \frac{A R^a + B R^b + C R^c}{A + B + C} = D$$

By this method the superior health condition of Hobart Suburbs is revealed in comparison with the City. Notwithstanding (owing to the abnormal proportion of ages 65 and over in the former), the total death-rate of the Suburbs was 22·44 per 1000 living, while the City only showed 16·36 per 1000 living; the correction for age disproportion having the effect of reducing the former to 16·63 per 1000 living, and increasing the latter to 17·10 per 1000 living. The limitation to deaths under 65 years of age is also most significant in confirming the accuracy of the Health Standard as a true measure of Relative Health.

Ordinary Total Death-rate disregards Longevity.

But the fundamental objection to all unqualified Total Death-rate indices, when used as Comparative Health

Standards, is, that a life terminating one hundred years after birth is reckoned only to be of the same health value as a life terminating one hour after birth; and that the death of an octogenarian caused by "old age" or "senile decay"—a non-preventible cause—adds as much to the rate as the death of a child or youth from preventible causes, such as smallpox, diphtheria, or typhoid fever.

It is clear, therefore, before a true comparison can be made between the health of different places, or between different periods in any one place, the non-preventible deaths due to "old age," or the natural termination of a healthy life, should be eliminated, and the comparison strictly confined to preventible causes, or, otherwise, the healthiest place in the world might seem the worst, and the most unhealthy the best.

In the comparisons between the present and the past of Hobart and between the death-rates of different cities, this plan has been carefully carried out in the following tabular comparisons.

The adoption of this course is all the more necessary when we come to consider the remarkable longevity of the inhabitants of Hobart as compared with other places, as indicated in the following table :—

PROPORTION of Persons who die of "Senility" or "Old Age" in various Cities to Total Deaths from all causes.

Hobart Suburbs	1 in every	3 persons who die.
Hobart and Suburbs.....	1 "	5 "
Hobart, City only	1 "	7·65 "
Adelaide	1 "	14 "
Average of eight principal Cities of Scotland	1 "	31 "
London	1 "	35 "
Melbourne	1 "	39 "
Sydney	1 "	40 "

As over 20 per cent. of the total death-rate of Hobart is composed of the numbers of those who die of "old age," it will be seen how misleading it would be to compare its health with the other cities named on the basis of the total death-rate from all causes, including preventible and non-preventible.

Indeed, if there be anything to fear in our Death-rate statistics, it is, that anyone who comes to reside in this City has the chance of 1 in 5 that he will prolong his life to extreme old age.

PAST AND PRESENT HEALTH OF HOBART COMPARED.

The following table contrasts the proportions of deaths from preventible causes under the great classes of Disease for the years 1894-5 with the average proportion from corresponding causes in the preceding ten years, and also with the abnormal epidemic year 1887.

DEATHS per 100,000 persons living.

	Average of		Epidemic Year 1887.	Years 1894-5, above + or below —.	
	Years 1894-5.	10 Years 1884-93.		Average Decade, 1884-93.	1887.
Zymotic Diseases	170	266	416	— 96	— 246
All other Preventible causes—					
Parasitic Diseases.....	5	8	16	— 3	— 11
Dietic Diseases	6	22	46	— 16	— 40
Constitutional Diseases.....	249	275	282	— 26	— 33
Developmental Diseases ...	37	48	62	— 11	— 25
Local Diseases	657	852	767	— 195	— 110
Violence	70	74	98	— 4	— 28
Ill-defined Diseases.....	87	197	216	— 110	— 129
Total other Preventible Diseases	1111	1476	1587	— 365	— 476
All Preventible Diseases.	1281	1742	1903	— 461	— 622

The rate of 12·81 per 1000 persons living is a remarkably low death-rate for any city in respect of all preventible causes of death. It is lower than the average of the preceding ten years by 33 per cent., and lower than that of the epidemic year by 33 per cent.

Confining our attention to Zymotic diseases alone, which include nearly all the principal infectious and contagious diseases, and therefore coming well within the scope of sanitary concerns, we find that the death-rate—1·70 per 1000—from all such forms of disease during years 1894-5 was 37 per cent. below the average of the preceding ten years, and as much as 59 per cent. below the epidemic year 1887.

There can be no doubt, therefore, that Hobart has been in a most healthy condition during the last two or three years, and compares most favourably with any former period in her history.

The following table shows more particularly the principal specific causes of death from preventible diseases for the same periods, shown in the order of their importance :—

DEATHS per 100,000 persons living.

From	Average of		Epidemic Year 1887.	Years 1894-5, above + or below —.	
	Years 1894-5.	Ten Years 1884-93.		Mean of Ten Years 1884-93.	Epidemic Year 1887.
Non-preventible cause—					
Senile Decay, "Old Age" ..	326	462	538	— 136	— 212
Preventible causes—					
Heart Diseases, various ...	130	163	193	— 33	— 63
Phthisis	129	147	171	— 18	— 42
Atrophy and Debility	80	179	193	— 99	— 113
Cancer.....	61	77	75	— 16	— 14
Diarrhœa and Dysentery...	53	102	170	— 49	— 117
Pneumonia	52	79	82	— 27	— 30
Typhoid, &c.	50	81	200	— 31	— 150
Bronchitis	48	88	36	— 40	+ 12
Apoplexy	33	62	59	— 29	— 26
Convulsions	29	65	69	— 36	— 40
Premature Birth	27	42	53	— 15	— 26
Drowning	27	20	23	+ 7	+ 4
Diphtheria	21	26	26	— 5	— 5
Fractures, Contusions	15	16	23	— 1	— 8
Dentition	11	17	26	— 6	— 15
Paralysis	3	33	26	— 30	— 23
All others	512	554	478	— 42	+ 34
All Preventible Diseases ...	1281	1742	1903	— 461	— 622

From the preceding table it is seen that the decline in the death-rate from all preventible causes in the last two years is traceable in every one of the principal specific causes of death, with the exception of a slight increase in deaths from Drowning, Bronchitis, and all other minor specific causes relative to 1887. The most marked fall is to be found under *Atrophy* and *Debility*, *Diarrhœa* and *Dysentery*, *Typhoid*, *Pneumonia*, and *Convulsions*. The figures, as a whole, are eminently satisfactory, and confirm the statement already made, that Hobart during the last two and even three years has never been in a healthier condition. That it compares also most favourably among the healthiest cities of the world will be demonstrated in the tables and facts which follow.

HOBART COMPARED WITH OTHER TOWNS AND CITIES.

The following table compares the death-rate from preventible diseases in Hobart with corresponding death-rate in other cities of Australia and Great Britain :—

DEATHS FROM PREVENTIBLE CAUSES ONLY IN VARIOUS CITIES AND TOWNS.

(*Death-rate per 1000 persons living.*)

	Period.	All Preventible Causes.	Zymotic Diseases.
Hobart	1895	11·84	—
Hobart, mean.....	1894-5	12·26	1·70
Sydney, mean	1894-5	13·22	—
Melbourne, mean	1894-5	15·28	—
Adelaide.....	1894-5	15·70	—
Hobart, mean.....	1884-93	17·42	—
Coatbridge	1893	17·52	3·53
Aberdeen	1893	17·57	2·07
Sydney, mean.....	1884-93	17·92	3·06
Leith	1893	18·72	3·48
Edinburgh	1893	19·25	2·85
Melbourne, mean	1884-93	19·30	2·26
Average of 100 English towns, mean	1884-93	19·40	—
Govan and Partick	1893	20·09	5·11
London	1893	20·20	3·71
Greenock	1893	20·33	4·47
Paisley	1893	20·48	3·77
Perth (Scotland)	1893	20·99	3·65
Adelaide, mean	1891-93	21·50	3·65
Dundee	1893	21·69	4·50
Glasgow	1893	22·63	4·49
Kilmarnock	1893	23·67	7·22

The figures for eliminating “old age,” and so confining comparisons to Preventible Causes only, are not available in respect of many other cities and towns of Great Britain and Australia with which Hobart compares most favourably. Among the 117 cities and towns where this elimination was rendered possible, Hobart, by a long lead, takes the first position as a city of health. Sydney takes the second. The worst in order being the town of Kilmarnock, in Scotland.

The superiority of Hobart and Sydney as healthy cities is further confirmed by a comparison of the principal specific causes, as in the following table, whose figures, as in other tables, are taken directly from the Blue Books of the several Registrars-General. The figures for Great Britain and Australia refer to the year 1893; those for Hobart to the mean of the two years 1894-5.

(Per 100,000 persons.)

Principal Specific Causes.	Hobart.	Sydney.	Aberdeen.	Coatbridge.	Leith.	Edinburgh.	Melbourne.	Govan & Partick.	London.	Glasgow.	Adelaide.	Perth (Scotland.)	Dundee.	Kilmarnock.	Average of principal Scotch Towns.
Heart Disease, var.	130	*	*	*	*	*	—	*	160	*	*	*	*	*	159
Phthisis	129	—	201	160	185	163	—	170	187	160	—	203	180	234	199
Atrophy & Debility	80	—	*	*	*	*	—	*	67	*	*	*	—	*	67
Cancer	61	—	84	48	69	114	—	40	80	48	—	60	69	72	72
Diarrhoea and															
Dysentery	53	—	57	77	59	41	—	65	79	77	—	93	129	206	77
Pneumonia	52	—	115	152	169	135	—	192	165	152	—	136	210	155	179
Typhoid	50	56†	11	58	24	16	68†	12	17	29	—	13	27	155	25
Bronchitis	48	—	180	179	162	182	—	176	240	179	—	199	274	182	206
Apoplexy	83	—	70	53	58	67	—	44	51	53	—	139	67	107	66
Convulsions	29	—	*	*	*	*	—	*	51	*	*	*	*	*	35
Premature Birth ...	27	—	*	*	*	*	—	*	*	*	*	*	*	*	*
Drowning	27	—	*	*	*	*	—	*	8	*	*	*	*	*	7
Diphtheria	21	39†	29	32	49	23	—	27	76	21	36	13	23	28	29
Dentition	11	—	10	3	8	9	—	15	11	3	—	17	3	14	13
Paralysis	3	—	39	54	37	43	—	19	28	54	—	63	42	21	42
Scarlet Fever	—	—	12	16	52	21	—	21	37	3	—	43	3	100	28
Measles	—	—	20	48	78	61	—	239	38	204	—	53	148	41	112
Influenza	26	—	52	10	14	34	—	4	*	29	—	30	10	45	20
Whooping Cough...	—	—	5	64	34	61	—	108	54	46	—	76	85	110	79
Small-pox	—	—	1	—	14	—	—	—	5	—	—	3	1	—	2

* Not ascertained.

† Mean of 17 years.

INFANTILE MORTALITY.

There is another very sensitive index to the comparative health of different times and places, viz., deaths under one year compared in proportion with births. The following table shows the infantile mortality in the principal towns and cities of Great Britain and Australia, based, when not otherwise stated, on the average of the years 1877 to 1886:—

Infantile Mortality in Towns of Great Britain and Australasia.

(Deaths under 1 year to 1000 Births.)

Preston	218	Twenty-eight English	
Dundee (1893)	218	Towns	161
Leicester	201	Newcastle	160
Blackburn	187	Wolverhampton	159
Liverpool	183	Halifax	159
Salford	178	Sunderland	157
Bolton	177	Plymouth	157
Nottingham	175	Kilmarnock (1893)	157
Manchester	174	Govan (1893)	157
Brisbane (1883 to 1887) ...	174	Leith (1893)	156
Norwich	173	Brighton	148
Adelaide (1884 to 1887 ...	172	Edinburgh (1893)	148
Leeds	172	Glasgow (1893)	146
Cardiff	169	Bristol	145
Huddersfield	169	Derby	143
Oldham	169	Paisley (1893)	142
Melbourne (1878 to 1888). ...	169	Wellington (1883 to 1887). ...	142
Sydney (1878 to 1888) ...	168	Portsmouth	138
Birmingham	164	Birkenhead	137
London (1893)	164	Perth (1893)	135
Sheffield	163	Greenock (1893)	134
Bradford	162	Aberdeen (1893)	125
Hull	161	Hobart { (1895)	125
		{ (1894)	108

Here, again, the favourable position taken by Hobart as contrasted with 65 principal towns in Great Britain and Australasia is shown in that its infantile mortality is by far the lowest of all, as in all deaths from every preventible cause.

CONCLUSION.

Particular climates and latitudes favour the development of certain diseases, to which they are in some cases peculiarly restricted; and in widely distributed diseases, such as the Zymotic, particular climates and latitudes, independently of sanitary conditions, have a direct influence in favouring or

lowering the intensity of any attack. Of course altitude and other local circumstances may powerfully counteract the general influences in some places ; but, nevertheless, speaking in a broad way, it is apparent that the attacks of Typhoid diminish in intensity in either hemisphere in passing from the equatorial to polar latitudes ; and just the reverse of this happens in other diseases, such as Bronchitis.

Therefore, the hygiene or healthiness as a whole of any one locality cannot be properly estimated in contrast with any other by a restricted reference to the intensity or otherwise of any one particular form of disease. In making contrasts of this kind between place and place, conclusions based upon any single form of disease would to a certainty be very misleading and unsatisfactory : the general effect of all forms of preventible diseases is alone satisfactory and conclusive.

In the three preceding tabular comparisons, which conclusively establish the fact that the present health condition of Hobart has never been so good, and that it is preeminently one of the most healthy cities in the world, every care has been taken to make a particular and thorough contrast of all the principal causes of preventible disease, and the results shown are so obvious that even the most ignorant or the most sceptical who gives the matter any attention cannot fail to be convinced by them ; and that figures logically, carefully, and consistently arrayed are most eloquent agents in support of truth, are not in any way affected by the vulgar platitude that "figures may be made to prove anything." But even figures cannot make the false appear true unless they are mishandled.

In this connection a curious ethical consideration presents itself. Why is it that people who are specially noted for the readiness with which they accept palpably crude and foolish statements and opinions, without the slightest effort exerted to test their truth, should also be the people who are most ready to express the greatest mistrust of figures, and to strain at or resist carefully reasoned conclusions if distasteful, even though supported by the very best authority ? I do not, however, anticipate that it can possibly be distasteful to anyone to accept the conclusions regarding the healthful condition of Hobart established in the preceding statements and tabular comparisons.

The inhabitants of this beautiful city, instead of using unreasoning expressions of discontent with their present local condition, should indeed be grateful to God that there are few, if any, cities of the world that enjoy such highly favourable health conditions, and so genial a climate. Those who praiseworthy endeavour to increase and maintain the good health of

the city by care and improvement of all sanitary provisions, should not mar their good work by giving any encouragement to unwarranted alarmist statements regarding the general good fame and health of the city we live in, and which, at the present time, is the most healthy of any city known to me.

DEATH Rate per 100,000 persons under each of the great divisions of diseases in four Metropolitan Cities during 1894.

	Melbourne.	Sydney.	Adelaide.	Hobart.	
				1894.	1895.
I. Specific Febrile or Zymotic Diseases	162	232	218	180	182
II. Parasitic Diseases.....	5	5	3	14	6
III. Dietic Diseases.....	19	14	20	3	8
IV. Constitutional Diseases..	328	236	383	281	248
V. Developmental Diseases.	111	106	150	382	336
VI. Local Diseases.....	782	653	683	751	661
VII. Violence	81	74	45	90	72
VIII. Ill-defined, &c.....	67	92	90	90	90
All Causes	1555	1412	1592	1791	1603
Less "Old Age"	48	45	123	346	306
All Preventible Causes ..	1507	1367	1469	1445	1297

DEATHS under 1 Year per 1000 Births, 1894.

MELBOURNE.	SYDNEY.	ADELAIDE.
122	133	119

PERCENTAGE of Deaths from "Old Age" to All Deaths, 1894.

MELBOURNE.	SYDNEY.	ADELAIDE.	HOBART.	
3·06	3·19	7·70	19·32	19·09*

Actual Number.

210	190	49	123	111*
-----	-----	----	-----	------

Per 100,000 mean Population.

47·5	45·0	122·6	346	306*
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* Year 1895.

DEATHS of Persons 65 Years and over.

Actual Number.

MELBOURNE.	SYDNEY.	ADELAIDE.	HOBART.	
1894.	1894.	1894.	1894.	1895.
1359	731	160	237	189

Per cent. to Total Deaths.

19·78	11·27	20·56	37·21	32·48
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Per 100,000 mean Population.

308	175	400	666	521
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HOBART AND SUBURBS.

POPULATION, Deaths, and Death-rate, under Principal Specific Causes, for the Year 1895.

	Actual.			Relative.		
	City.*	Suburbs	Both.*	City.	Suburbs	Both.
Estimated Mean Population—						
0-5 years.....	3467	1199	4666	12·83	12·92	12·85
5-65 years.....	22,390	7246	29,636	82·87	78·06	81·64
65 and over.....	1161	837	1998	4·30	9·02	5·51
All Ages.....	27,018	9282	36,300	100·00	100·00	100·00
Deaths—						
0-5 years.....	123	29	152	34·55	15·68	28·09
5-65 years.....	151	56	207	42·42	30·27	38·27
65 and over.....	82	100	182	23·03	54·05	33·64
Total { Preventible.....	321	109	430	90·17	58·93	79·48
{ Non-preventible..	35	76	111	9·83	41·07	20·52
{ Both.....	356	185	541	100·00	100·00	100·00
Death-rate per 1000 persons living—						
0-5 years.....	..	..	..	35·48	24·19	32·58
5-65 years.....	..	..	..	6·74	7·73	6·99
Under 65 years.....	..	..	..	10·60	10·07	10·47
65 and over.....	..	..	..	70·63	119·47	91·10
Ditto, Preventible only ..	..	..	..	48·23	26·29	39·03
All Ages { Preventible.....	..	..	..	11·88	11·74	11·84
{ Non-preventible ..	..	..	..	1·30	8·19	3·06
Total.....	..	..	..	13·18	19·93	14·90
Health Standard—						
Deaths from all preventible causes, corrected for age disproportion.....	..	..	..	12·54	10·81	11·94
Deaths from all causes, corrected for age disproportion.....	..	..	..	13·56	15·05	14·30
Principal Specific Causes—				Per 100,000 persons living.		
Non-preventible Causes—						
Old Age.....	35	76	111	130	819	306
Preventible Causes—						
Heart Disease, various.....	24	14	38	89	151	105
Phthisis.....	27	9	36	100	97	99
Atrophy and Debility.....	21	9	30	78	97	83
Pneumonia.....	18	7	25	67	75	69
Typhoid.....	14	6	20	58	65	55
Diarrhœa and Dysentery.....	21	3	24	78	32	66
Cancer.....	17	2	19	63	22	52
Bronchitis.....	9	1	10	33	11	27
Apoplexy.....	8	2	10	30	22	27
Premature Birth.....	7	2	9	26	22	25
Drowning.....	—	5	5	—	54	14
Convulsions.....	5	2	7	18	22	19
Diphtheria.....	5	1	6	18	11	16
Fractures.....	2	2	4	7	22	11
Dentition.....	4	—	4	15	—	11
Paralysis.....	—	3	3	—	32	8
All Preventible Causes.....	321	109	430	1188	1174	1184

* Hospital Deaths, &c. referred to the District in which the cause of death originated.

DISCUSSION.

MR. MAULT (Engineering Inspector of the Central Board of Health), in opening the discussion, said that Mr. Johnston in his very able paper had so completely proved that Hobart was one of the healthiest cities in the world, and that the only true method of usefully comparing the health conditions of towns was, not by considering their respective "Total Death Rates," but by regarding their "Health Standard Rates," as to leave the main purpose of the paper beyond discussion. But, while fully agreeing with this main purpose, there were several portions of the paper he could not agree with. For instance, Mr. Johnston in his opening sentences, after referring to the very low death-rates from preventible diseases during the last three years in Hobart, says:—"Whatever may be the cause or combination of causes which, during the last three years, have raised the City of Hobart into a healthier state than that of any other period of its history, and have constituted it pre-eminently as among the healthiest cities of the world, it is obvious that local, artificial, or sanitary provisions have had very little to do with it, for a similar fall in preventible causes of death, if not so great, is distinctly traceable throughout Australia and Tasmania generally during the same period, as shown in"—a table which he gives. That was a very astonishing statement, especially as the table that is said to prove it proves nothing of the kind, but only shows that there has been going on for some time a coincident diminution of death-rates in the various Australian Colonies. The cause of this coincidence was surely not far to seek, especially as the cause of a similar diminution in the home countries was well known to be better sanitary administration.

From the passing of the Registration Act of 1838 in England till the year 1875, in which the present Public Health Act was passed, the rate of mortality, though varying greatly from year to year—the differences being sometimes more than 4 to the 1000—continued to average for the whole period 22·55 to the thousand living. But on the passing of the Act improved sanitation began immediately to tell on the death rate: for the first five years, that is 1875-1879, the mean rate was 21·2 to the 1000; for the next five years it was reduced to 19·6 to the 1000; and during the next five years it was further reduced to 18·6 to the 1000. And the rate was not only lowered, but it was steadied. Once, three years after the passing of the Act, the rate rose about 0·6 to the 1000, but since then it has never risen more than 0·4 to the 1000. With regard to the reduction effected, it is a remarkable fact that the maximum

death-rate since the year 1880 has never attained the height of the minimum death-rate of all antecedent time in England.

Now, to compare English and Australian experience by the aid of the information given in Mr. Johnston's table. The table as it stands is not satisfactorily arranged, as it compares the experience of ten years with that of two. But, if divided, as has been done with the English tables, into three equal periods, a fair comparison can be made, especially as Mr. Johnston's table begins at about the period of the passing of most of the Australian Health Acts. The effect of the passing of these Acts is thus shown in the death-rates of the chief cities of the Colonies in the order given by Mr. Johnston—

	Death-rates in the periods		
	1884-1887.	1888-1891.	1892-1895.
Hobart.....	23·65	21·14	18·27
Sydney.....	21·15	17·35	14·11
Melbourne.....	20·59	20·64	16·14
Adelaide	25·12	22·93	19·99

—the rates being to the thousand living. To attribute this diminution to anything but the coinciding administration of the Health Acts in all the colonies shows an ignorance of the scope of these Acts and of the manner in which they are carried out, especially in connexion with infectious diseases, which are the most amenable to administrative action, and are the chief causes of periodical variations in death-rates. Every such disease has to be notified to the Central Board, and immediately upon such notification the local sanitary authority has to inspect the premises where the case has occurred, and report the measures that have been taken to remove the cause and prevent the spread of the disease. These measures alone have had a great effect upon the death-rate; but apart from them, the routine work of the Inspectors of the local boards, especially in the larger towns, has also had the result of preventing much disease. And still further, in some of the colonies, in addition to the general provisions of the Health Acts with respect to milk and food, special legislation provides for dairy and slaughter-house inspection. How all these sufficient causes for the amelioration of life conditions in these colonies—paralleled as they are by the action of similar causes elsewhere—can be overlooked or set aside, and their results attributed to such cosmic influences as periodicities in the revolution of Jupiter or of the prevalence of sun-spots, passes comprehension.

That some cosmic influences affect the irregular ebb and flow of mortality rates is not denied. A diagram of the mortality

in England from 1848 to the present time shows a very irregular but very marked tidal action ; but it also shows—and this is the most important fact it does show—that up till 1875 there was no controlling influence over this tidal action, but that since that date an influence, growing more and more potent as sanitary administration grows more and more efficient, is so controlling the tide as to now almost obliterate all traces of periodical rise and fall.

If, instead of taking the general death-rate, the death-rate of one of the infectious diseases that are the most amenable to sanitary effort be taken, this controlling influence is yet more clearly seen. Take typhoid fever, for instance. In Mr. Johnston's table of deaths from the principal specific causes the line for typhoid fever deaths is singularly treated. For the British towns the deaths from this fever are recorded for one year ; for Hobart the mean rate for the last two years is given ; for Sydney and Melbourne the mean of 17 years is taken ; and the rate for Adelaide is not given at all. With such divergence of data no real comparison can be made. But if the rate for the three Australian towns for 1894 be taken, the real condition of the towns mentioned will be, for each 100,000 people :—

London.....	17
Average of principal Scotch towns.....	25
Sydney.....	29
Adelaide	35
Hobart.....	50

Mr. Johnston says :—“ In making contrasts of this kind between place and place, conclusions based upon any single form of disease would to a certainty be very misleading and unsatisfactory : the general effect of all forms of preventible diseases is alone satisfactory and conclusive.” This may be true from a statistician's point of view when regarding general healthiness or unhealthiness, but from a sanitarian point of view the real value of statistics is to point out where and how sanitary work is most needed and can best be done. As already mentioned, typhoid is one of the diseases most amenable to the influence of sanitary work, especially drainage, and the figures just given point out that Hobart, though a very healthy place, may be made yet more healthy by the prevention of typhoid. Before the passing of the Health Act in England the average death-rate from typhoid fever was 89 in 100,000, as compared with 21 now. At Sydney it was 102 in 1885, and is 29 now. At Adelaide there has been a corresponding reduction. Why should not similar work be done here ?

There is a point in connection with the healthiness of Hobart that should be more widely known—its comparative freedom

from consumption. This is probably due to the unusual dryness of the air as shown by the great divergence between the readings of dry and wet bulb thermometers. This is not one of the least of the claims of Hobart to be the sanatorium of Australasia.

In conclusion, all experience shows that whatever cosmic influences may be at work, the healthiness or unhealthiness of a place depends greatly on human work. It may be still impossible to "bind the sweet influences of Pleiades, or loose the bands of Orion," but it is possible to safeguard the purity of our air and the healthiness of our city, and take away the reproach of our past negligence.

Major-General TOTTENHAM said it seemed to him that there was one other matter which required consideration as a factor in the judgment of healthiness of a place or district, whether as to natural or artificial conditions. He disclaimed any desire to decry or fix the stigma of unhealthiness on Hobart. He came to Hobart 11 years ago hardly able to walk half a mile at a snail's pace, and his tolerably known capacity in locomotion now needed no statistics to attribute to the healthful air of Tasmania. It was a deep debt of gratitude which had impelled him to advocate so strenuously and persistently improved sanitation in Hobart, in order that the health of the city—the healthiest he had ever seen in the world, and he had seen a good many—should be rendered still healthier. (Applause.) What he complained of was the existence in past years of preventible disease unwarranted by the exceptional advantages of the site, and due, in his opinion, and not in his alone, to municipal neglect of sanitary laws. (Warm applause.) Mr. Johnston had placed before them a series of tabular statements, the burden of each being a death rate. Those tables showed undoubted statistical acumen and patient research. The "mortality of disease" was well set forth, but he (Major-General Tottenham) had searched in vain for the "prevalence of disease," as indicated by the number of cases of preventible disease occurring in each city reviewed. The exclusion of only "old age and senile decay" from preventible causes classified all other deaths amongst the possible. That, unintentionally no doubt, gave a false view as regarded "sanitary state" for diseases were due to public as well as private responsibility or neglect of such. The ordinary acceptance of the term "preventible disease" was disease by governmental or municipal decree, so to speak. There should be no municipal or government neglect in this respect. (Applause.) The mere death-rate of a place could not be

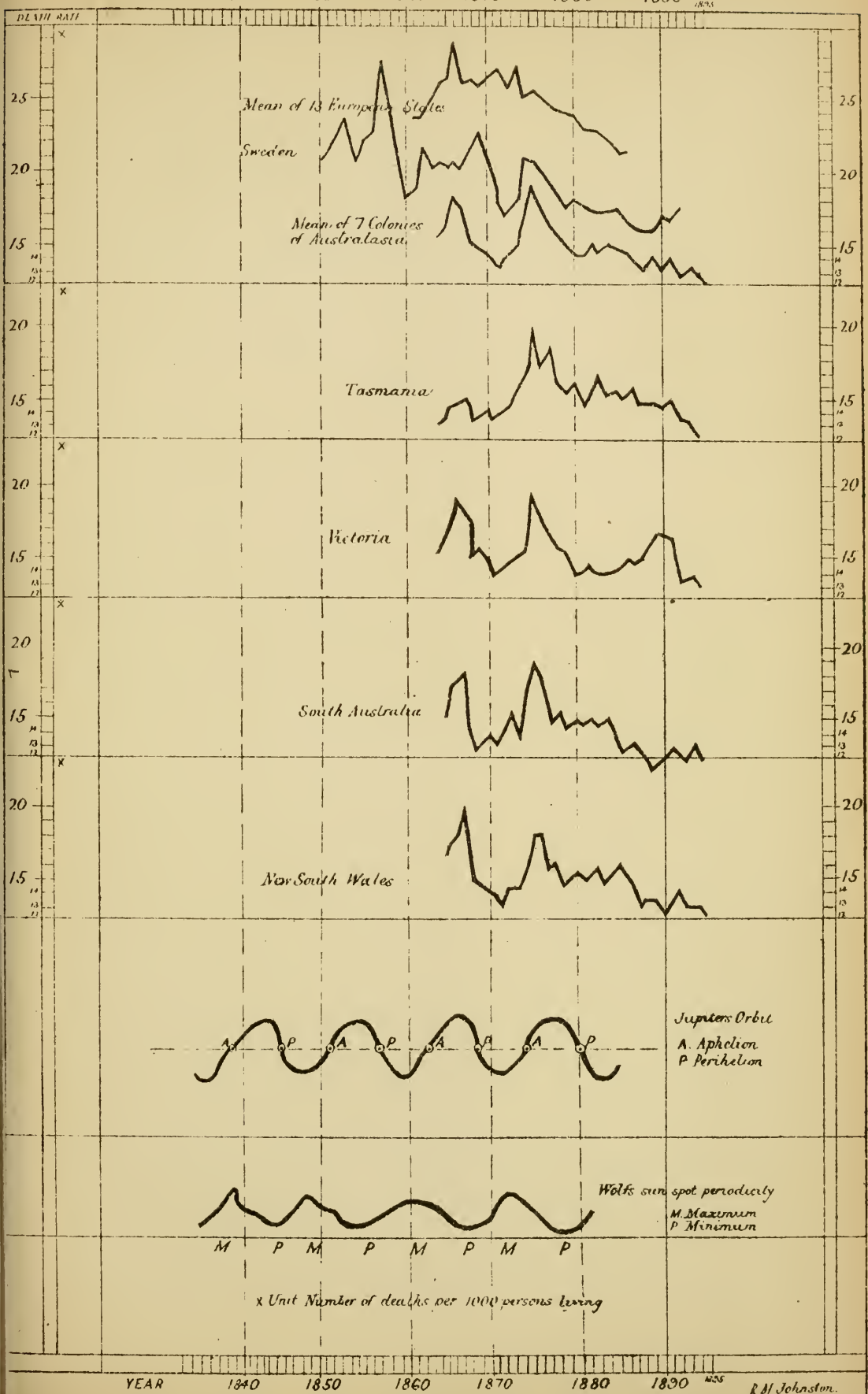
regarded as a fully trustworthy test of its healthfulness. All the fever cases in Hobart were not notified, and the speaker gave statistics to support his contention. As Mr. Johnston had indicated, without accurate statistics they could not know, prove, or compare anything. As a soldier he could not afford to "enthuse" over statistics the bases of which were, to say the least, of uncertain origin. (Applause.)

Mr. W. F. WARD (Government Analyst) considered that Mr. Johnston's paper could not fail to convince anyone who would take the trouble to read it carefully, that excluding the deaths of old people, which formed such a large proportion of the deaths, and the old must die, Hobart death-rate was lower than that of other Australasian cities. But even this was not sufficient to attract the attention of visitors, and so he suggested that the monthly statements might either be so modified as to emphasise every time the high rate from old age alone occurred, or that the vital statistics be published at longer intervals, with full details. The question, however, was not, he thought, so much one of figures as of the general health reputation of the place, and in this we had suffered somewhat, owing, in the first place, to a few conspicuous cases of diphtheria last summer, and in the second, to perhaps a greater degree, to a statement repeated again and again that the town smelt to quite an unusual extent; that bad odours were, in fact, "frequent and painful and free," the cause being the want of rain to wash the town. Now, the ordinary passer-by did not stop to investigate, but classed everything which offended his or her nostrils comprehensively as "drains," declaimed accordingly, and anticipated germs, although it might be no more than the powerful but harmless water in which a cabbage had been boiled. (Laughter and applause.) Yet the good name of the city suffered. (Hear, hear.) There was no necessary connection between bad smells and infectious diseases. Human beings could often, for long periods, eat, drink, and breathe more or less filth, and be apparently not much the worse until the specific germs are somehow introduced which then increase, multiply, and spread in the congenial soil, so that typhoid and diphtheria were known as "filth diseases." It followed, therefore, that though offensive odours might in some cases be practically harmless, yet there was no reason why they should be tolerated if they could by any possibility be got rid of, and if enthusiasts had occasionally exaggerated their effects as well as the death-rate, yet enthusiasm carried most reforms, and had in this case great, if not full, justification. (Applause.)

Mr. JOHNSTON, in replying on the discussion, said he was glad that the main object of his paper had been accomplished. It was his endeavour to show the distinction between the sanitation of a place and its healthfulness; that it did not necessarily follow that while the sanitary conditions were not as complete as they might be, therefore its health was bad, for during a time being a city might be in a bad state of health, and yet have the best system of sanitation in the world. It seemed to be conceded on all sides that Hobart in the last two or three years had been in a most satisfactory condition as regards its health, but there were differences of opinion as to the causes. He had studied the subject for many years, and still believed that whilst sanitation was valuable in reducing certain diseases, such as typhoid, the great causes of such diseases were still beyond man's control. The percentages had fallen low in some years before any Health Acts were passed, although he admitted that in England typhoid fever cases had of late years been greatly reduced. Too little credit seemed to be given to the increased knowledge of medical men in the treatment of such diseases, and the improved habits of the people. He agreed with Mr. Mault that sanitary agencies were powerful influences in reducing the number of fever cases, but they were not the only ones, and they did not produce such good results as one should like to see. As to what Major-General Tottenham had said about the returns supplied to and used by statisticians not being reliable, the objection cut the ground from the objector's own feet, as he had quoted such statistics himself. (Laughter.) He would, however, be sorry if the effect of his paper would be that decreased attention would be given in Hobart or anywhere else to the importance of sanitation. (Applause.)

DEATH RATE PERIODICITY OF VARIOUS COUNTRIES COMPARED

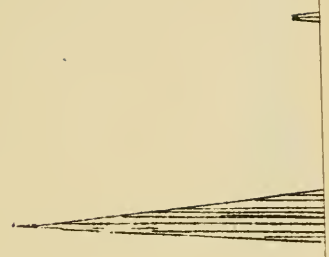
YEAR 1840 1850 1860 1870 1880 1890



TYPHOID DEATH RATE HOARAT DISTRICT SINCE
 YEAR 1868.

65 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95-

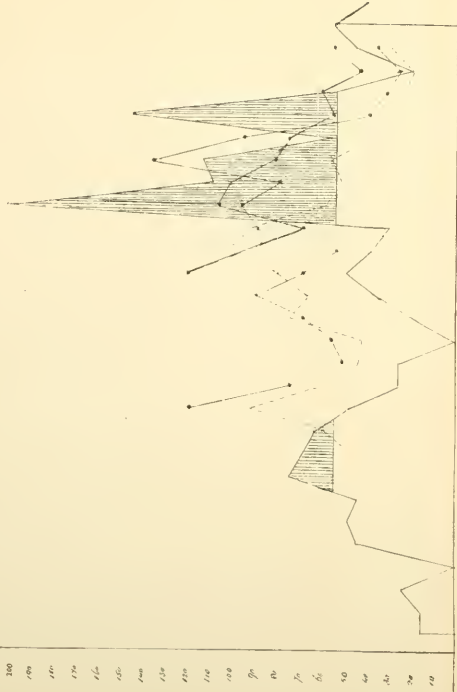
DEATH RATE PER 100,000
200
190
180
170
160
150
140



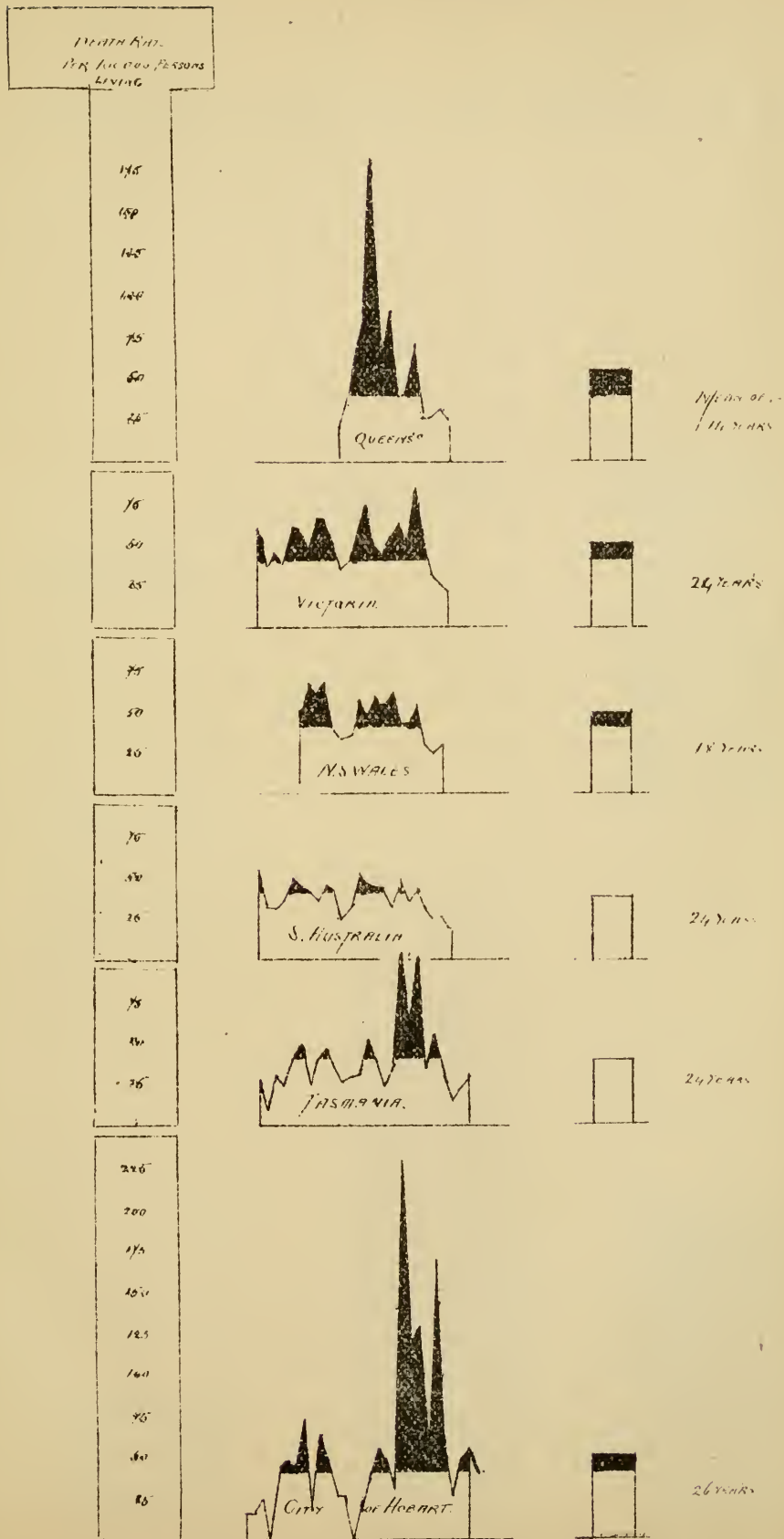
TRIMMED CROWN PIGEON HORNET DISTRICT SINCE

65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

CROWN PIGEON
SINCE



TYPHOID CURVES FOR FIVE COLONIES OF AUSTRALASIA SINCE YEAR 1870.



PROPORTION OF DEATHS 1895

FROM PRINCIPAL CAUSES IN

The diagram illustrates the progression of diseases from childhood to old age, organized into three vertical columns representing different stages of life. The columns are labeled at the top as 'HUMART CITY', 'HUMART', and 'HUMART + 30'. The diseases listed in the columns are:

- Childhood (Left Column):** Measles, Whooping Cough, Diphtheria, Typhoid, Pneumonia, Heart Disease, Various.
- Old Age (Middle Column):** Heart Disease, Various.
- Senility (Right Column):** Heart Disease, Various.

The columns are connected by dashed lines, indicating the progression of diseases over time. The diagram is a hand-drawn sketch with various labels and lines.

A CLASSIFIED LIST OF THE MINERAL SPECIES KNOWN TO OCCUR IN TASMANIA.

(BY W. F. PETTERD.)

SYNOPSIS.

I. NATIVE ELEMENTS.

II. SULPHIDES, TELLURIDES, SELENIDES, ARSENIDES, ANTIMONIDES, BISMUTHIDES.

III. COMPOUNDS OF CHLORINE, BROMINE, IODINE.

IV. FLUORINE COMPOUNDS.

V. OXYGEN COMPOUNDS.

I. Oxides, or Binary Oxygen Compounds.

- i. Oxides of Elements of Gold Iron, and Tin Groups
- ii. Oxides of Elements of Arsenic and Sulphur Groups.
- iii. Oxides of Elements of Carbon-Silicon Group.

II. Ternary Oxygen Compounds.

1. Silicates.

A. Anhydrous Silicates.

- i. Bisilicates.
- ii. Unisilicates.
- iii. Subsilicates.

B. Hydrus Silicates.

- i. General Hydrus Silicates.
- ii. Zeolites.
- iii. Margarophyllite Section.

2. Tantalates, Columbates.

3. Phosphates, Arsenates, Antimonates, Nitrates.

A. Phosphates, Arsenates, Antimonates.

- i. Anhydrous.
- ii. Hydrus.

B. Nitrates.

4. Borates.

5. Tungstates, Molybdates, Vanadates.

6. Sulphates, Chromates, Tellurates.

- i. Anhydrous.
- ii. Hydrus.

7. Carbonates.

- i. Anhydrous.
- ii. Hydrus.

8. Oxalates.

VI. HYDROCARBON COMPOUNDS.

I. NATIVE ELEMENTS.

Antimony	Graphite	Osmiridium
Arsenic	Gold	Platinum (?)
Bismuth	Iron	Silver
Copper	Lead	Sulphur
Diamond	Mercury (?)	

II. SULPHIDES, ARSENIDES.

(Tellurides, Selenides, Antimonides, and Bismuthides are not known to occur.)

Sulphides.

Argentite	Greenockite	Pentlandite
Bournonite	Galenite	Pyrites
Bismuthenite	Heazlewoodite	Pyrrhotite
Berthierite	Huascalite	Stromeyerite
Boulangerite	Jamiesonite	Stannite
Bornite	Marcasite	Sternbergite
Chalcopyrite	Molybdate	Sphalerite
Cinnabar (?)	Maratite	Stephanite
Covellite	Millerite	Stibnite
Chalcocite	Plagionite	Tetrahedrite
Dufrenosite	Przibramite	Tennantite

Sulph-Arsenides.

Arsenopyrite
Cobaltine
Glancodite
Proustite

Arsenides.

Leucopyrite
Niccolite
Smaltine

III. COMPOUNDS OF CHLORINE, BROMIDE, AND IODINE.

Atacamite	Embolite	Iodyrite
Cerargyrite	Halite	Matlockite

IV. FLUORINE COMPOUNDS.

Chlorophane	Fluorite	Yttrite
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V. OXYGEN COMPOUNDS.

I. Oxides, or Binary Oxygen Compounds.

i. Oxides of Elements of Gold, Iron, and Tin Groups.

Asbolite	Chromite	Minium
Anatase	Diaspore	Pyrolusite
Beauxite (?)	Franklinite	Psilomelane
Brookite	Göethite	Pleonaste (spinel)
Brucite	Hematite	Periclasite
Cuprite	Limonite	Rutile
Corundum	Massicot	Stilphnosiderite
vars.	Magnetite	Wad
Sapphire	Melaconite	Zincite
Oriental Topaz	Menaccanite	

ii. Oxides of Elements of Arsenic and Sulphur Group.

Arsenolite	Kermesite	Valentinite
Bismite	Molybdine	Wolframite
Cervantite	Senermontite	

iii. Oxides of Elements of Carbon-Silican Group.

Quartz.

A. Vitreous vars

Rock crystal

Smoky.

B. Crypto-crystalline vars.

Basanite, Chalcedony, Cornelian, Prase, Sinter, Chert, Jasper, and others.

C. Other vars.

Common Opal, Resin, Wood and Semi-opal, Hydrophane, Cacholong, Menilite, Hyalite, Geyserite, and Infusorial Earth.

II. Ternary Oxygen Compounds.

1. Silicates.

A. Anhydrous Silicates.

i. Bisilicates.

Arfvedsonite	Enstatite	Pyroxene
Actinolite	Hypersthene	Schiller-spar
Augite	Hornblende	Tremolite
Asbestos	Hidenbergite	Wollastonite
Beryl		

ii. Unisilicates.

Adularia	Iolite
Axinite	Lepidomelane
Anorthite	Labradorite
Biotite	Lithomarge
Chrysolite (Olivine)	Lepidolite
Epidote	Muscovite
Eulytine	Orthoclase
Garnet	Obsidian
vars.	Oligoclase
Almandite	Porcellanite
Grossularite	Pitchstone
Aplome	Smithsonite
Idocrase	Zircon
Ilvarite	

iii. Subsilicates.

Andalusite	Kyanite	Titanite (Sphene)
Collyrite	Pycnite	Tourmaline
Euclase	Sillimanite (?)	Topaz

B. Hydrous Silicates.

i. General Section of Hydrous Silicates.

Allophane	Chrysocolla
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ii. Zeolite Section.

Chabazite	Natrolite	Scolecite
Laumontite	Phillipsite	Stilbite
Mesolite	Phacolite	Thompsonite

iii. Margarophyllite Section.

Chlorite	Pimelite
Cimolite	Rhodochrome
Fahlunite	Serpentine
Geothite	vars.
Halloysite	Chrysotite
Kaolinite	Marmolite
Kammererite	Picrolite
Miloschite	Picrosmine
Noutronite	Retinalite
Chrome-ochre	Steatite
Pholerite	Sericite
Pyrophyllite	Talc

2. Tantalates and Columbates.
Fergusonite.

3. Phosphates, Arsenates, Antimonates, and Nitrates.

A. Phosphates, Arsenates, Antimonates.

i. Anhydrous.

Alipite	Monazite	Plumbogummite
Apatite	Pharmacosiderite	Scorodite
Mimetite	Pyramorphite	

ii. Hydrous.

Annatergite	Erythrite	Wavellite
Bindheimite	Pitticite	Leucochalcite (?)
Evansite	Vivianite	

B. Nitrates.

(Not known to occur.)

4. Borates.

(Not known to occur.)

5. Tungstates, Molybdates, and Vanadates.

Scheelite	Wolframite
Vanadanite	Wulfenite

6. Sulphates, Chromates, and Tellurates.

i. Anhydrous.

Anglesite	Glauberite	Susannite
Barite	Leadhillite	Vauquelinite
Crocoisite	Melanochroite	

ii. Hydrous.

Alumogen	Goslerite	Melanterite
Copiapite	Gypsum (Selenite)	Morenosite
Epsomite	Halotrichite	

7. Carbonates.

i. Anhydrous.

Ankerite
Arragonite
Cromfordite
Calcite
Calamine

Cerussite
Dolomite
Magnesite
Plumbicalcite
Pennite

Rhodochrosite
Siderite
Sphaerosiderite
Strontianite

ii. Hydrous.

Azurite
Bismutite
Cyanosite

Dundasite
Hydromagnesite

Malachite
Zaratite

8. Oxalates.

(Not known to occur.)

VI. HYDROCARBON COMPOUNDS.

Asphaltum
Coal
Lignite

Copalite
Pelionite
Retinite

Shale
Tasmanite



DESCRIPTION OF A SMALL COLLECTION
OF TASMANIAN SILURIAN FOSSILS PRE-
SENTED TO THE AUSTRALIAN MUSEUM
BY MR. A. MONTGOMERY, M.A., GOVERN-
MENT GEOLOGIST, TASMANIA,

BY

R. ETHERIDGE, JUN^R.,

Curator, Australian Museum, Sydney.

PLATE.

(Reprinted from the Secretary for Mines' Report.)

1.—INTRODUCTION.

SOME time ago, Mr. A. Montgomery, M.A., Government Geologist of Tasmania, presented to the Australian Museum a small collection of Silurian fossils from Zeehan and Heazlewood.

As so little is at present known of the organic remains occurring in the sedimentary rocks of these important mineral fields, a few notes on their affinities may not be out of place, notwithstanding the very poor state of preservation of the fossils. However, any facts that may be evolved from their elaboration will perhaps be of use to future investigators who may have the good fortune to take up the subject hereafter.

The occurrence of organic remains at the above localities does not appear to have come under the notice of Mr. R. M. Johnston at the time he wrote his valuable work, "The Systematic Account of the Geology of Tasmania;"¹ perhaps even they had not been discovered, and all that I know on the subject is gleaned from the official Reports of Messrs. Thureau and Montgomery.

¹ Quarto, Hobart, 1888. (By Authority.)

2.—GEOLOGY.

Mr. G. Thureau informs us¹ that the rocks containing the silver-lead ores at Zeehan belong to the Silurian series, and consist of very much contorted dark blue shales and grey sandstones. The fossils he noticed were "Trilobites, Polyzoa, Corallites, Crinoids, and Brachiopoda." Of the Zeehan deposits, Mr. Montgomery says² the country rock consists of Silurian grits, sandstones, and slates, in many places much bent, contorted, and twisted. The central portion of the Heazlewood District, he remarks,³ is composed of Silurian sandstones and limestones, &c.

Mount Zeehan is situated in the County of Montagu, on the west coast of Tasmania, to the east of Trial Bay, some distance north of Macquarie Harbour, and between the Badger River and the coast. Heazlewood is still further north, north-east of the town of Corinna, in County of Russell, as shown on "Sketch Map—General Geological Features of Tasmania," in Johnston's work.

3.—LIST OF THE FOSSILS BY LOCALITIES.

HEAZLEWOOD.—

Favosites grandipora, *Eth. fil.*

Hausmannia meridianus, *Eth. fil.* and *Mit.*

ZEEHAN.—(Despatch Limestone.)

Asaphus, *sp. ind.*

Hausmannia meridianus, *Eth. fil.* and *Mit.*

Hausmannia, *sp. ind.*

Illæus Johnstoni, *Eth. fil.*

Amphion? *brevispinus*, *Eth. fil.*

Leptodomus? *nuciformis*, *Eth. fil.*

Eunema Montgomerii, *Eth. fil.*

Orthoceras, *sp. ind.*

HEAZLEWOOD.—(Blue-grey schistose rock.)

Cornulites tasmanicus, *Eth. fil.*

Cromus Murchisoni, *De Kon.*

Rhynchonella decimplicata, *J. de C. Sby.*

Rhynchonella capax, *Conrad.*

Tentaculites, *sp. ind.*

¹ Mount Zeehan Silver-Lead Lodes and other Deposits, 1888, p. 1.

² Report on the State of the Mining Industry on the West Coast, 1890, p. 7.

³ *Ibid*, p. 15.

ZEEHAN.—(Blue-grey schistose rock.)

Cornulites tasmanicus, *Eth. fil.*

Cromus Murchisoni, *De Kon.?*

Rhynchonella borealis, *Schlotheim?*

Rhynchonella cuneata, *Dalman.*

Strophodonta, *sp. ind.*

Tentaculites, *sp. ind.*

ZEEHAN.—(White quartzite.)

Lophospira? *sp. ind.*

Murchisonia, *sp. ind.*

Raphistoma, *sp. ind.*

The Collection also contains other forms too indefinite for determination.

4.—NOTES ON THE SPECIES.

Corals.

Favosites grandipora, *Eth. fil.?*

F. grandipora, *Eth. fil.*—Records Australian Museum, 1890, I., No. 3, p. 61, t. 8, f. 6-9.

Obs.—Certain specimens of a Favosite in highly decomposed limestone recall the typical features of this species, the corallites highly thickened internally, and the walls copiously perforated by very large uniserial pores close together. The whole of the tabulæ have been dissolved, leaving no trace of their presence. Beyond an extra amount of thickening of the corallite walls, the present specimens do not add to our knowledge of the structure of *F. grandipora*. It is naturally somewhat difficult to speak with certainty of the species when dealing with such highly decomposed species, but I believe this to be identical with the coral I described under the above name from the Lilydale Limestone of Victoria.

Loc.—Heazlewood, in limestone.

Genus PLEURODICTYUM, *Goldfuss.*

(Petref. Germaniæ, 1829, I., p. 113.)

Pl., Fig. 1.

Obs.—The impression of ten or more corallites is, I believe, referable to this genus. The outline of each individual corallite is polygonal, the spaces formerly occupied by the walls being represented by partial grooves; here and there small connecting processes represent the mural pores.

The size of the corallites would favour the view here advanced, rather than a reference to *Favosites*.

Loc.—Zeehan, in a light coloured schistose rock.

Trilobites.

Genus *HAUSMANNIA*, *Hall & Clarke*.

(Pal. New York, 1888, VII., pp. XXIX. and XXXI.)

Hausmannia meridianus, *Eth. fil. & Mitchell*.

Pl., Figs. 4 & 6.

H. meridianus, *Eth. fil. & Mitchell*, Proc. Linn. Soc. N.S.W., 1895, X (2), p. 504.

Obs.—A fragmentary pygidium of a large *Hausmannia* occurs amongst the Heazlewood specimens. It corresponds in all particulars,—large size, wide and very long axis, and the greatly increased number of segments in the latter,—to the N. S. Wales examples that Mr. John Mitchell and the writer have distinguished by the name of *meridianus*. The tail apex is not preserved, so that the peculiarities of this portion visible in Bowning specimens need not be referred to.

The size of the specimen is one and a quarter inches long by one and three-quarters broad, and there are eleven or twelve pleural segments more or less exposed to view. The increase in the number of axial segments in the pygidium over and above the normal of the typical *Hausmannia caudatus*, Brün., is not peculiar to the present form. According to Salter¹ the pygidium axis of *H. caudatus* should possess 11-12 segments, but the late M. Barrande mentions² as many as 18-19 in *H. Hausmanni*. Numerous instances of more than twelve could be cited; for example, the American Devonian *H. ohioensis* has seventeen axial segments and a terminal appendage.

Loc.—Heazlewood; and Zeehan, in the Despatch Limestone.

Hausmannia, *sp. ind.*

Pl., Fig. 5.

Obs.—Several specimens of a possible second form exist as portions of pygidia, having the same general characters as the preceding species. In the best preserved example, however, there are but nine axial segments visible, all of

¹ Mon. Brit. Trilobites, 1864, Pt. 1, p. 49.

² Syst. Sil. Bohême, 1852, I., p. 538.

which show traces of a tuberculation that has never been seen on any of the N.S. Wales or Victorian specimens of *Hausmannia*. The limb in decorticated individuals is exceedingly wide and slightly concave. The pleural segments also bore tubercles, and, from the presence of this form of ornament, I am led to expect that the present examples are distinct from those before referred to under the name of *H. meridianus*.

A similar tuberculated pygidium, as well as cephalic-shield exists in *H. verrucosus*, Hall,¹ of the Niagara Group of Indiana, U.S.A.

Loc.—Zeehan, in the Despatch Limestone.

Genus *ASAPHUS*, *Brongniart*.

(Crust. Foss., 1822, p. 17.)

Asaphus, *sp. ind.*

Pl., Fig 2.

Obs.—A single small pygidium, seen from the concave interior, is, I think, referable to *Asaphus*. It is three-quarters of an inch long, by nearly the same wide. The pygidium appears to have been gently arched, with a flattened border, a narrow long axis extending to the limb at the apex, and very faint traces of short coalesced pleural segments. The specimen is sufficiently preserved to show the presence of the genus in these rocks, and no more. As compared with the pygidia in the Caroline Creek beds, it is in the first place longer (*i.e.*, from before backwards) than *Asaphus*, *sp. a.*², but shorter than in *sp. b.*, but is less oval, and more angular in the centre of the posterior border than either of them. Of the two, it is more nearly allied to *sp. a.*, but I do not think identical with either.

Loc.—Zeehan, in the Despatch Limestone.

Genus *ILLÆNUS*, *Dalman*.

(Kongl. Vet. Acad. Handl., 1826, p. 248.)

Illænus Johnstoni, *sp. nov.*

Pl., Fig. 3.

Obs.—Two specimens are in the collection, both slightly pressed out of shape; one is unquestionably a glabella, the other is more indefinite, and it is difficult to say whether

¹ Indiana Geol. Survey Report, 1881 [1882], XI., p. 345, t. 35, f. 7, 14-17.

² Etheridge, Junr., Proc. R. Soc. Tas. for 1881 [1882], t. 1, f. 6.

it is a glabella or pygidium. The glabella measures one inch long, the transverse measurement being the greater—viz., one and a quarter inches. There is every reason to believe that this glabella was fairly convex or gibbous, particularly about the centre. The axial grooves are wide and deep (in the decorticated state), and wide apart, curving slightly outwards, but not sufficiently to form a lobe as is sometimes the case in this genus, such, for instance, as in *I. tauricornis*, Kut.¹; these grooves are also rather short, extending but little beyond what would be the position of the eyes were the latter preserved. The glabella narrows towards the front, which is steep or highly inclined; posteriorly it slopes off gradually to the neck-furrow, and does not overhang the latter as in some forms. The precise course of the facial suture cannot be followed, from the amount of lateral pressure the specimen has undergone, and the same fact will no doubt to some extent affect the degree of convexity of the glabella. On the side least affected in this way, the facial suture seems to be fairly straight and but little curved.

The neck furrow, from glimpses of it that can be obtained seems to have been very fine and narrow, and the neck-lobe similarly so. In a few species of *Illænus*, such for instance as *I. revalensis*, Holm,² the glabella possesses three oval depressions on each side, representing the glabella furrows, but these have left no trace on our specimen. The surface (*i.e.* decorticated) is devoid of sculpture, except along the anterior margin, where a few parallel and semi-anastomosing grooves are visible.

I have never before had the good fortune to see an *Illænus* either from Australian or Tasmanian rocks, nor, so far as I am aware, has the genus been described from those of the latter Colony; but De Koninck has recorded³ the presence of *I. Wahlenbergii* from the Upper Silurian of New South Wales, but without giving a figure. At the same time there is a strong resemblance, in *I. Johnstoni*, to this species, notwithstanding that the cephalic shield of our fossil is imperfect, showing neither the eyes nor the free cheeks. Under these circumstances the measurements previously given can only be accepted provisionally. On

¹ Holm, Mém. Acad. Imp. Sci. St. Pétersbourg, 1886, XXXIII., No. 8, t. 6, f. 10, & 11a.

² *Loc. cit.* t. 2, f. 4 a & b, 5 a & b.

³ Foss. Pal. Nouv.-Galles du Sud, 1876, Pt. 1, p. 46.

the other hand, the axial grooves of *I. Wahlenbergii*, Barr.,¹ are considerably longer than those of our form, and more or less circumscribe the glabella, and with these facts before me, I think it better to distinguish the latter by a separate name.

Loc.—Zeehan, in the Despatch Limestone.

Genus CROMUS, *Barrande*.

(Syst. Sil. Bohême, 1852, I., p. 821.)

Cromus Murchisoni, *De Koninck*.

Pl., Figs. 7 & 8.

C. Murchisoni, De Koninck, Foss. Pal. Nouv.-Galles du Sud, 1876, Pt. 1, p. 54, t. 1, f. 8.

Obs. The larger portion of a cephalic shield and four pygidia, all with the test removed.

De Koninck has complicated the discrimination of this and allied species by erroneous references to his figures. For instance, he describes the head and tail of *Encrinurus Barrandei*, De Kon., but refers to the figure (his Fig. 8, Pl. 1) only. He likewise describes the cephalic shield of *Cromus Murchisoni*, and refers to the figures of both cephalic shield and pygidium (his Figs. 9-9b, Pl. 1), at the same time stating that both the thorax and pygidium were unknown to him. In other words, Prof. De Koninck reversed the numbers of the figures on his first plate. Fig. 8 should be *Cromus Murchisoni*, and Figs. 9-9b should be referred to *Encrinurus Barrandei*. That such is the case is evident by bearing in mind the generic differences of the cephalic shield of the two forms in question.

In the Tasmanian specimens the larger portion of the glabella, the neck segment and portions of the fixed cheeks, are preserved. The positions of the glabella furrows are distinctly marked by the large five primary tubercles on each side, the furrows in the east being short and somewhat wide. Between each of these points the surface is occupied by four or five secondary tubercles ranged in a line, whilst on the anterior part of the glabella smaller tubercles of a tertiary order become numerous. The neck segment is strong and wide. Neither of the pygidiums are wholly preserved. There are twenty-six coalesced segments at least in the axis, which tapers to a very fine apex. The central line is devoid of segmentation, and

¹ Syst. Sil. Bohême, 1852, I., p. 684.

there appear to be only four strong tubercles along it. The coalesced pleuræ are very much less in number.

Another Australian Trilobite of this group has been described¹ by Mr. A. F. Foerste as *Encrinurus Mitchelli*, but whether I am correct or not in my determination of the Tasmanian forms, I think Foerste's species is identical with them.

Loc.—Heazlewood, in a blue-grey schistose rock ;
? Zeehan, in the same matrix.

Genus AMPHION, *Pander*.

(Beiträge Geog. Russich. Reiches, 1830, p. 139.)

Amphion? *brevispinus*, *sp. nov.*

Pl., Fig. 9.

Obs.—Two small pygidiums, disassociated from other parts, are referred to under this name. In the number of the coalesced segments, backward direction of the pleuræ, embracing as they do the termination of the axis, and spinose free ends, these fossils seem to agree with the pygidium characters of the genus *Amphion*.

There are five axial segments, and a terminal appendage, and five pleuræ, the whole of the component parts being rather widely separated from one another by deep grooves, whilst the outward terminations of the axial segments are slightly nodular. The pleuræ are a good deal arched downward, and the two last on each side quite posteriorly directed. The terminal appendages are large relatively to the size of the pygidiums, but this is not uncommon in the genus. The free ends of the pleuræ do not project far beyond the margins, and are more perceptible in a portion of one of the specimens, as a bluntly-toothed edge.

The brevity of the pleural spines causes a resemblance to the pygidium of *Amphion Fischeri*, Eichwald, as figured by Hoffmann,² but not only is the terminal appendage in *A.?* *brevispinus* longer, and generally larger, but the whole pygidium of the latter is shorter and wider than that of the European tail.

A.? *brevispinus* is probably nearest to *A. pseudoarticulatus*, Portlock,³ resembling this British species both in the number of its segments and shortness of its spines.

Loc.—Zeehan, in the Despatch Limestone.

¹ Bull. Sci. Lat. Denison Univ., 1888, III., t. 13, f. 2, 3, 20.

² Verhandl. Russ.-K. Min. Gesellsch. St. Petersburg, Jahr. 1857-58 [1858], p. 34, t. 3, f. 4.

³ Report Geol. Londonderry, &c., 1843, t. 3, f. 5 c.

Annelida.Genus CORNULITES, *Schlotheim*.

(Petrefaktenkunde, 1820, p. 378.)

Cornulites tasmanicus, *sp. nov.*

Pl., Fig. 10 & 11.

Obs.—Several decorticated casts of this interesting supposed Tubicolar Annelid occur at both localities. The longest example is one and a half inches, and in that space portions of at least thirteen or fourteen rings or annulations are visible. In a small fragment preserved in the round, the greatest diameter is three-eighths of an inch. The inverted conical annulations are broad, measuring fully one-eighth of an inch in the direction of their growth, and with the semi-imbricating appearance common to the genus.

As the specimens are but casts of the interior, it cannot be expected that any trace of the fine longitudinal microscopic striæ that ornament the exterior of these organisms would be preserved, but one impression, apparently of an outer surface, exhibits a concentric wrinkling that may possibly represent the irregular outer surface of a *Cornulites*. A similar irregularity of surface is excellently shown in Prof. Hall's figure of *C. proprius*¹ from the Niagara Group of Indiana State. The internal annulated casts are very like those of the characteristic *C. serpularius* of the European Wenlock beds, but the annulations are longer (*i.e.*, longitudinally). The sharp and distinctly annulated form of the segments in these tubes also finds a counterpart in *C. armoricanus*, Ehlert,² from the French Devonian rocks. Again, a striking resemblance exists in the strongly imbricate and subindibuliform condition of the segments in our casts to Prof. Hall's figures of *C. chrysalis*,³ a species of the Lower Helderberg Group of N. America. Many other comparisons might be made, but these are sufficient to indicate the relations of our form.

Loc.—Heazlewood, in a blue-grey schistose rock; Zeehan, in a white to grey schistose rock.

¹ Indiana Geol. Survey Report, 1881 [1882], XI., p. 327, t. 32, f. 4; 28th Ann. Report N. York State Mus. Nat. Hist., 1879, t. 31.

² Bull. Soc. Etudes Sci. Angers, 1887, t. 10, f. 5, 5 a & b.

³ Pal. N. York, 1888, VII. t. 116, f. 26-28.

Brachiopoda.Genus *RHYNCHONELLA*, *Fischer*.

(Notice Foss. Gouv. Moscou, 1809, p. 35).

Rhynchonella decimplicata, *J. de C. Sby.**Rhynchonella decimplicata* (J. de C. Sby.), Davidson, Mon. Brit. Sil. Brachiopoda, 1869, III., Pt. 7, No. 3, p. 177, t. 23, f. 20-24.*Rhynchonella decimplicata*, M'Coy, Prod. Pal. Vict., Dec. V., 1877, p. 26, t. 47, f. 3-6.

Obs.—A number of crushed examples of this species are associated with the remains of *Cromus Murchisoni*, but are sufficiently well preserved to exhibit the distinctive features of the species. *R. decimplicata* has already been met with in the Upper Silurian of Victoria by M'Coy, and although figured by Mr. R. M. Johnston in his "Geology of Tasmania," is not, I think, from Tasmanian rocks.

Loc.—Heazlewood, in a grey-blue schistose rock.

Rhynchonella cuneata, *Dalman*.

Pl., Fig. 16.

Rhynchonella cuneata (Dalman), Davidson, Mon. Brit. Sil. Brachiopoda, 1867, Pt. 7, No. 2, p. 164, t. 21, f. 7-11.*Rhynchonella cuneata*, Johnston, Syst. Acc. Geol. Tas., 1888, t. 7, f. 9.

Obs.—An impression of a single ventral valve possessing the general characters of this species tends to confirm Mr. Johnston's recognition of it as a Tasmanian fossil, but the number of costæ seem to separate it as a variety. In *R. cuneata*, Dalm., the costæ are from ten to fourteen, of which four or five occur on the fold of the dorsal valve, and three or four in the sinus of the ventral. On the impression from Zeehan there are ten costæ, but only one of these occurs in the sinus. The shell evidently possessed the same cuneate form and elevated umbo. There is, however, no trace on this cast of a punctate surface similar to that of the American shell. Prof. James Hall has referred to this species, and erected it into a separate genus under the name of *Rhynchotreta*;¹ neither did Dr. T. Davidson recognise this structure in European examples of *R. cuneata*.

Johnston's figure, from the shading, I take to be a dorsal valve, with three costæ on the fold.

Loc.—Zeehan, in a blue-grey schistose rock.

¹ 28th Ann. Report N. York State Cab. Nat. Hist., 1879, p. 166.

Rhynchonella capax, Conrad, sp.

Pl., Fig. 17 & 18.

Rhynchonella capax (Conrad, sp.), Meek, Report Geol. Survey Ohio, 1873, I., Pt. 2, p. 123, t. 11, f. 6a-f.

Obs.—A number of very beautiful external impressions, often of the united valves, seem to me to be referable to this species. They represent a rounded sub-globose form, with close rather inrolled beaks, a well-marked fold and sinus, and numerous sub-angular costæ, sometimes very fine, crossed by innumerable decussating laminae. The costæ do not exceed twenty in number, but vary from sixteen to twenty, seven to eight on the flanks, one to three on the dorsal fold, seldom three, however, and only one or two in the ventral sinus. The convexity of the valves is about equal, and the fold relatively wider than the sinus. The zigzag laminae increase rapidly in width and prominence towards the front.

In general habit, casts taken from these impressions are very like *Rhynchonella capax*, of the Hudson River Group of North America, and equally so of *R. Lewisii*, Davidson,¹ from the Wenlock Limestone of England, for indeed the latter shells differ but little from one another.

In *R. capax* the lateral costæ are from four or five to seven, on the dorsal fold four, and in the ventral sinus three. In *R. Lewisii* there are from two to five costæ in the fold, and one to four in the sinus.

The Tasmanian impressions are certainly after the type of these closely allied species, but apparently closer to *R. capax*, in fact separated chiefly by the relative number of costæ. I therefore propose for our shell the varietal name of *meridionalis*, and would write it in full as *R. capax*, var. *meridionalis*, Eth. fil.

Rhynchonella anticostiensis, Billings,² is also a close ally, in fact Meek regards it as a synonym of *R. capax*. It possesses four ribs on the fold and three in the sinus.

In addition to the number of costæ, the Tasmanian shells differ only in being relatively smaller and less globose than the American.

Loc.—Heazlewood, in a blue-grey schistose rock.

¹ Mon. Sil. Brachiopoda, 1869, Pt. 7, No. 3. p. 180, t. 23, f. 25-28.

² Pal. Foss. Canada, 1862, I., Pt. 3, p. 142, f. 119a-c.

Rhynchonella borealis, *Schlotheim*?

Pl., Fig. 19 & 20.

Rhynchonella borealis (Schl.), Davidson, Mon. Brit. Sil. Brachio-poda, 1869, Pt. 7, No. 3, p. 174, t. 21, f. 14-20.

Obs.—Numerous examples of a crushed *Rhynchonella* have yielded characters that place it very near to the above species, particularly one variety figured by Davidson (*see* his. t. 21, f. 18, 18a.)

I believe the fossils are the remains of a subtrigonal shell, with the fold of the dorsal valve abruptly raised, with wide smooth sides, and the crown of the fold longitudinally and narrowly sulcate, the single rib or costa thus formed on each side being sharp and well defined. The flanking costæ, from three to four in number, are also prominent and sharp. The sinus of the ventral valve is wide and deep, with two insignificant costæ at the bottom close together. There are four costæ on each flank, and the intercostal spaces or valleys on both valves are deep. The whole surface of the valves is crossed by very strong concentric frills.

Our fossils are not only closely allied to the form of *R. borealis*, already indicated, but also to its variety *diodonta*, Dalman, and they have some characters in common with *R. bidentata*, Hisinger,¹ and *R. altiplicata*, Hall,² of the Lower Helderberg Group of North America, but, as regards the former of these, not possessing so high a dorsal fold, and more costæ.

Loc.—Zeehan, in a greyish-white schist.

Genus STROPHOMENA, *Rafinesque*.*Strophomena*? *sp. ind.*

Pl., Fig. 12.

Obs.—An impression of a very peculiar Strophomenoid shell that is worth figuring to draw attention to it, although of doubtful generic identity. There is evidence of a large sinus, thereby indicating a ventral valve. The sinus is too pronounced for the specimen to be a species of *Orthis*, except such species as *O. biforata*, Schlotheim, of the Middle and Upper Silurian, but it is unlike the latter in outline. So far as mere shape is concerned it approaches *Tropidoleptus*, Hall, or *Enteletes*, Fisher.

Loc.—Zeehan.

¹ Davidson, *loc. cit.*, 1883, V., Pt. 2, p. 150, t. 10, f. 3, a & b.

² Pal. N. York, 1852, II., p. 231, Atlas, t. 33, f. 2 a-b.

Genus STROPHODONTA, *Hall*.

(Pal. New York, 1852, II., p. 63.)

Strophodonta, *sp. ind.*

Pl., Figs. 13-15.

Obs.—Crushed and fragmentary examples of a Strophomenoid shell are numerous in the rock from the Silver King Mine, bearing many delicate, curved, radiating costæ. The chief point of interest is the presence of a crenulated hinge-line, the impressions of numerous transverse denticles. This character indicates the genus *Strophodonta* rather than *Strophomena*. The crenulations extend from one end of the hinge-line to the other, on each side the fissure. The shell was semi-oval, and provided with a large number of fine costæ, simply radiating on the centre of the valves, but gradually curving outwards on the flanks.

Loc.—Zeehan, in a greyish-white schistose rock.

Pelecypoda.Genus LEPTODOMUS, *M'Coy*.

(Brit. Pal. Foss., 1852, Fascic. 2, p. 277.)

Leptodomus? nuciformis, *sp. nov.*

Pl., Fig. 28.

Obs.—A small shell that it is difficult to refer positively to any genus, but having the general appearance of *Leptodomus*, M'Coy. It has an oblong-oval convex valve, with a straight posterior hinge-line, a rather high umbo, a faint indication of a cincture, and numerous well-marked fine concentric rugæ that unite towards the ventral margin into groups or bundles representing growth stages. The anterior margin is obliquely rounded, whilst the posterior margin is, although generally rounded, somewhat semi-truncate also.

Although no absolute proof exists that this is a true *Leptodomus*, still, from its general resemblance to that genus, I have provisionally placed it therein, with the trivial name *nuciformis*, from its rounded and compact nut-shaped outline. It is quite sufficiently distinct for future recognition.

Loc —Zeehan, in the Despatch Limestone,

Gasteropoda.Genus *LOPHOSPIRA*, *Whitfield*.

(Bull. Am. Mus. Nat. Hist., 1886, I., No. 8, p. 312.)

Pl., Fig. 24.

Obs.—It is with some hesitation that I refer the impression of a fragmentary univalve to this genus, characteristic of the Trenton Limestone of North America, and the Wenlock Limestone of the Island of Gotland. By taking a cast of the impression we see the remains of a turreted shell, with sharply carinated whorls, and generally presenting a bold and somewhat rugged appearance. There are portions of four whorls, each divided almost in the centre by a strong and sharp carina, the surface of each whorl above it being more or less concave, and below nearly straight walled. Our cast corresponds better with Lindström's figure of *L. bicincta*, Hall, sp.¹, than it does with Whitfield's types. Whatever may be the ultimate resting-place of the former, I think the Tasmanian cast will be found congeneric, although sufficient of the body whorl is not preserved to show the second or lower keel. All trace of sculpture has been removed.

There is no more evidence in our specimen than there is in Lindström's figure of the ultimate uncoiling of the whorls described by Whitfield as typical of his genus, and it is just possible therefore that the Gotland shells called *L. bicincta*, Hall, sp., by Lindström, may not be that species.

Loc.—Zeehan, in a white quartzite.

Genus *MURCHISONIA*, *D'Archiac* and *De Verneuil*.

(Bull. Soc. Géol. France, 1841, XII., p. 154.)

Pl., Fig. 23.

Obs.—This genus is represented by the elongated cast of a turreted-pyramidal shell, slowly increasing in size. There are five whorls (as preserved), almost straight sided, and swollen near the sutures, caused by a slight projection of the wide and apparently flat band, which on the upper whorls is situated at that point, but on the body whorl forms its periphery.

¹ *Pleurotomaria*, Sil. Gastropoda and Pteropoda of Gotland, 1884, p. 104, t. 8, f. 15-25.

Although only a fragment, this is a well marked shell. It belongs to that group of Murchisoniæ to some extent represented by *M. cingulata*, His., but differs in possessing straight-walled whorls and a more rapidly attenuating spire. The sculpture is unpreserved.

Loc.—Zeehan, in a white quartzite.

Genus EUNEMA, Salter.

(Canadian Organic Remains, 1859, Dec., I., p. 24.)

Eunema Montgomerii, *sp. nov.*

Pl., Fig. 21 & 22.

Sp. char.—Shell conical, turreted, of four non-oblique whorls, and a nucleus, encircled by prominent sharp carinæ, the first three whorls each bearing two, one immediately around the suture, the other near the middle; below this the sides of each whorl are straight-walled; body whorl with four keels, the three upper as already described, whilst the fourth is much more anterior in position—practically quite anterior—and somewhat oblique; the sides of each whorl between the first and second carinæ are concave, whilst the second carina is always the more prominent; the sutures are flat or very slightly concave; surface ornamented with microscopic thread-like lines of growth, varying slightly in direction between the encircling carinæ. Height of the largest specimen three-quarters of an inch.

Obs.—A very well marked shell, allied to *E. strigillatum*, Salter,¹ of the Trenton Epoch of North America, but broader in relation to its height, and differently directed carinæ. It affords me much pleasure to associate with this the name of Mr. A. Montgomery, Government Geologist of Tasmania. Johnston's *Trochonema Etheridgei*² is perhaps an allied, although distinct shell.

Loc.—Zeehan, in the Despatch Limestone.

Genus RAPHISTOMA, Hall.

(Pal. N. York, 1847, I., p. 28.)

Raphistoma? *sp. ind.*

Pl., Figs. 25 and 26.

Obs.—In the white sandstone from Zeehan several very poor casts of a low-crowned shell occur, difficult of determination, but having the appearance of this genus, and in

¹ Canadian Organic Remains, Dec., I., 1859, p. 29, t. 6, f. 4.

² Syst. Acc. Geol. Tas., 1888, t. 5, f. 13 and 14.

some respects resembling the form I have lately described as *R. Brownii*,¹ but lower in the spire, and therefore probably distinct. It is very desirable that additional examples of this fossil should be obtained, with the view of determining its systematic position with greater accuracy.

Loc.—Zeehan, in a white quartzite.

Pteropoda.

Genus **TENTACULITES**, *Schlotheim*.

(Petrefactenkunde, 1820, p. 377.)

Tentaculites, *sp. ind.*

Pl., Fig. 27.

Obs.—This elegant genus is represented by a very large number of external impressions. Casts taken from the latter display a remarkably elongate and delicate form, extending to a fine needle-point, but without any trace of the bulbiform embryonic shell. The characteristic annulations are about one-fourth or one-fifth millimetre apart, or four to five in number in the space of one millimetre. The interannular spaces are delicately transversely striated as usual in the genus. The annulations were very sharp, and apparently came to a fine edge.

Specific identification from the condition of the specimens is impossible, but it is a smaller form than that figured² by myself from the Siluro-Devonian rocks of the neighbourhood of Wellington, N. S. Wales.

Loc.—Heazlewood and Zeehan, in a blue-grey schistose rock.

5.—AGE.

The species detailed in the foregoing pages present both a Lower and an Upper Silurian facies, but with a preponderating tendency towards the latter. I think it not impossible that they represent a series of beds homotaxially equivalent to the lower portion of the Upper Silurian.

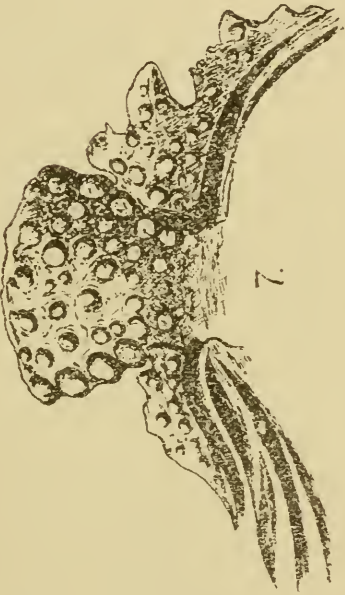
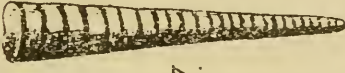
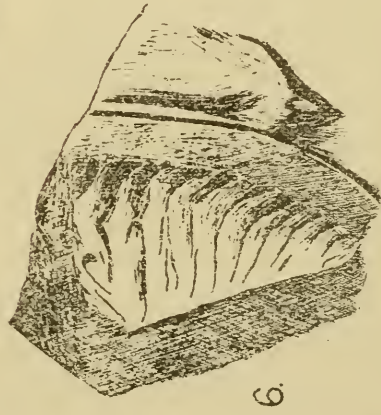
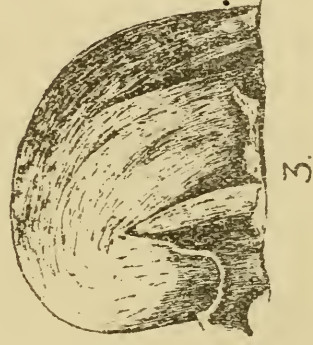
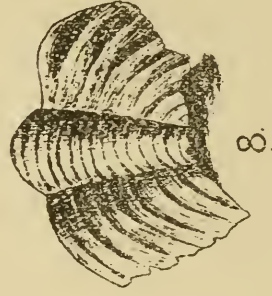
¹ S. Australian Parl. Papers, 1891, No. 158, p. 9, Pl., f. 1-3.

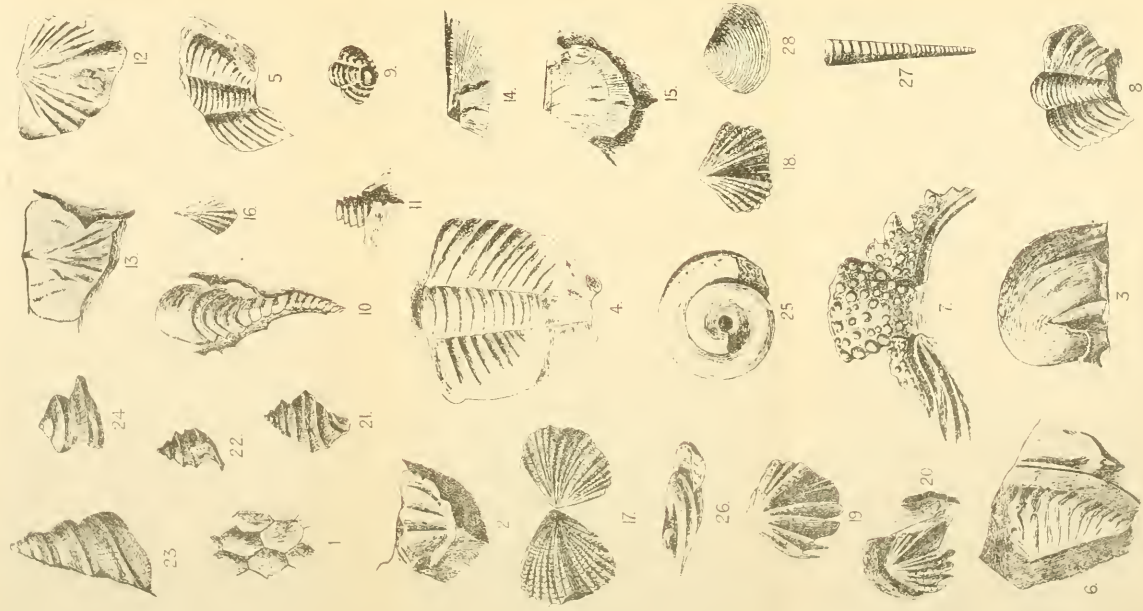
² Journ. R. Soc. N. S. Wales, 1880, XIV., p. 253, pl., f. 10.

DESCRIPTION OF THE FIGURES.

- Fig. 1. *Pleurodictyum?* sp. ind.—The impression of portions of ten corallites. The walls have entirely disappeared, leaving traces of the mural pores as small connecting shafts between the corallites. Zeehan.
2. *Asaphus*, sp. ind.—Small pygidium consisting of the test seen from the inside. Zeehan.
3. *Illænus Johnstoni*, Eth. fil. The cephalon or cephalic shield, with well marked axial grooves. Zeehan.
4. *Hausmannia meridianus*, Eth. fil. and Mitchell.—Pygidium showing the largely increased number of segments: cast from an impression. Heazlewood.
5. *Hausmannia*, sp. ind.—A smaller pygidium, probably of a distinct species, with the axis tuberculate. Zeehan.
6. *Hausmannia meridianus*, Eth. fil. and Mitchell.—The right coalesced pleuræ showing the wide limb. Zeehan.
7. *Cromus Murchisoni*, De Koninck.—The glabella and portion of the fixed cheeks— $\times 2$. Heazlewood.
8. The same.—Pygidium, with the apex wanting— $\times 2$. Heazlewood.
9. *Amphion?* *brevispinus*, Eth. fil.—Small pygidium, decorticated at the apex, but showing traces of the pleural spines— $\times 2$. Zeehan.
10. *Cornulites tasmanicus*, Eth. fil.—Internal cast of the tube. Heazlewood.
11. The same.—A smaller tube in the same condition. Heazlewood.
12. *Strophomena*.—Impression of a ventral valve? Zeehan.
13. *Strophodonta*, sp. ind.—Imperfect cast. Zeehan.
14. The same.—Hinge-line of Fig. 15 to show denticulations— $\times 3$. Zeehan.
15. The same.—Partially preserved cast. Zeehan.

- Fig. 16. *Rhynchonella cuneata*, Dalman.—Impression of the ventral (?) valve. Zeehan.
17. *Rhynchonella capax*, Conrad.—Cast taken from the impression of two valves in juxta-position— $\times 2$. Heazlewood.
18. The same.—A ventral valve— $\times 2$. Heazlewood.
19. *Rhynchonella borealis*, Schlotheim?—Cast of the ventral valve taken from an impression— $\times 1\frac{1}{2}$. Zeehan.
20. The same.—Zeehan.
21. *Eunema Montgomerii*, Eth. fil.—Showing general characters. Zeehan.
22. The same.—A smaller example. Zeehan.
23. *Murchisonia*, sp. ind.—Cast taken from an impression. Zeehan.
24. *Lophospira?* sp. ind.—Cast taken from an impression. Zeehan.
25. *Raphistoma?* sp. ind.—Internal cast, apical view. Zeehan.
26. The same.—Side view showing the keeled whorls. Zeehan.
27. *Tentaculites*, sp. ind.—Cast taken from an impression— $\times 6$ (about). Heazlewood.
28. *Leptodomus?* *nuciformis*, Eth. fil.—Left valve— $\times 3$. Zeehan.
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TUBERCULOSIS.

(a) CAUSE. (b) MODE OF INFECTION. (c) PREVENTION.

(1) BY THE INDIVIDUAL. (2) BY THE STATE.

(Read August 10th, 1896.)

BY GREGORY SPROTT, M.D., D.P.H., Health Officer for the
City of Hobart.*"In matters of prevention knowledge is power."*—Dr. Burdon Sanderson,
Harveran oration.

The subject I propose to deal with to-night is one of interest, not only to the medical and veterinary professions, but to every member of the community. Tuberculosis is one of the most widespread diseases we have to deal with, and causes more suffering to humanity than any other known disease at the present time. Its ravages are only equalled by those of small pox in the last century.

Preventive medicine has of late years done much towards the diminution of what we generally look upon as the infectious diseases, but has it been employed against the spread of tuberculosis in the same meritorious way? I am bound to tell you it has not, and yet there is no disease that the science of State medicine could be more profitably employed against than that of tuberculosis. It is indeed appalling to see so many of our young men and women cut off in the prime of man or womanhood. The choicest specimens of our race are frequently the first to go, and those who are not doomed to a speedy death are frequently chronic invalids, incapacitated for work.

No apology is therefore necessary for bringing before you a subject which is not only important to the individual, but to the whole of the nations which are so heavily burdened by it.

Tuberculosis is a specific infectious disease caused by the bacillus tuberculosis of Koch. It is common to man and the lower animals. In the human subject it appears in different forms—such as phthisis pulmonalis, tabes mesenteric, tubercular meningitis, scrofula, lupus, etc., but these are all causally related to the bacillus of Koch.

In the lower animals it is common to rabbits, guinea pigs, monkeys, fowls, etc. In the bovines it is known as "Perlsucht," or "Grapes."

Dr. Crisp stated he had met with it in more than one hundred species of animals, including quadrupeds, birds, and reptiles. Neither the goat nor the donkey are very subject

to it, and in the case of the donkey it is mostly recoverable. It has recently been artificially produced in fish. It may be said to be the most widespread disease we have in domesticated animals, though somewhat rare in their wild state.

There is no longer any doubt about the bacteriological identity of all these forms of tuberculosis in the different animals. It was at one time thought that the bacillus in tubercular fowls differed from that found in animals, but it is now generally believed that any slight difference that may exist can be accounted for by the different soil on which the bacillus is reared.

Wherever man goes we find tuberculosis, and where human beings are most crowded together, there the mortality is highest. No country is free from it, but the Faroe Islands, Iceland, Hebrides of Scotland, and the Highlands of Switzerland enjoy a marked relative immunity.

In many parts of the vast space of Africa, as in the Upper part of the Nile, it is almost unknown. In Algeria the free Arabs are not affected, while those in captivity readily contract the disease. It is prevalent in those who live in the heat of India or Australasia, as well as amongst those who are subjected to the colds of Canada and many parts of America, where it is said to be on the increase.

It is not therefore confined to any particular country, but, speaking generally, it is most prevalent in countries within the temperate zone, and especially amongst the most densely populated parts of these countries.

With its distribution climate would seem to have very little to do, but some observers hold it is more severe and rapid in tropical (India, China, and Japan) than in temperate regions.

All are agreed, however, that a moist, damp atmosphere is decidedly favourable to its prevalence. How this acts is not yet determined. It may have a direct action on the life history of the bacillus, or an indirect action by a relaxing effect upon the mucous membranes.

Certain seasons of the year have some influence over the prevalence. In Britain the maximum of phthisis is in March, April, and May, with a minimum in August, September, and October. The maximum of *tabes mesenteric* is, however, in July and August. It has a distinct relationship to the temperature, being most prevalent during the diarrhœa season. The minimum is in December, January, and February.

In Australasia the maximum occurs at different seasons in the various colonies.

No race of people are exempt, but the Jews seem to enjoy a comparative immunity.

Many of the races, such as the negroes, on changing their primitive mode of life and migrating to temperate climes, are peculiarly susceptible to the tubercular virus.

A very large percentage of the Maoris die of consumption, and in Queensland the death rate of phthisis is much swollen by the Kanakas.

Females are said to be more subject to tuberculosis than males, but this varies slightly in different colonies and countries. Tuberculosis is common among infants, and it is estimated that one-fourth of all children dying die of abdominal consumption.

Phthisis pulmonalis is commonest between the ages of 25 to 30 years. Ransome estimated that one-half of all deaths at marriageable ages are due to phthisis.

In 1891 one male died out of every 913 persons living, and one female out of every 1,190 in the Australasian group, excluding Western Australia.

I need not enter into the statistical part of this subject. Let me tell you it is the greatest single cause of death in the United Kingdom as well as in Australasia.

In England alone 70,000 deaths occur on an average every year, 50,000 of these being due to consumption of lungs; while the other 20,000 from other forms of tuberculosis.

In Australasia, for the three years 1890, 1891, and 1892, the total number of deaths from phthisis alone was 12,243, out of a total number of deaths of 153,069, being about 8 per cent. of all causes.

The following table * shows the death rate from phthisis per 100 deaths from all causes from years 1890, 1891, and 1892:—England, 11; Queensland, 8·9; Victoria, 8·9; New Zealand, 8·1; South Australia, 7·8; New South Wales, 6·9; Tasmania, 6·2; Western Australia, 5·9.

If we take the death rate per 100,000 persons living, and this is the more accurate method, for the same period as above the order is slightly different.

Deaths from phthisis per 100,000 persons living:—England, 164; Victoria, 136; Queensland, 116; South Australia, 97; Western Australia, 96; New South Wales, 90; Tasmania, 90; New Zealand, 81.

With the exception of New Zealand, our own colony has the best record.

If to the 4,081 that die annually from phthisis we add the number of deaths from other forms of tubercular diseases, we will have a total of at least of 6,000 lives lost to these colonies every year.

*See Dr. Mullin's paper in the *Australian Medical Gazette*, August 20, 1895.

You can readily see what an enormous saving of life it would be to the colonies, as well as to Britain, if we could only prevent this disease in its many forms.

When we consider the prevalence of this disease in man and animals, is it to be wondered at that so many have looked for the cause?

Galen, Morgagni, with Budd, were amongst those who from an early time considered it to be an infectious disease.

Klenche and Villenin were the first to show that sputum or tissue from dead tubercular subjects inoculated into rabbits produced tuberculosis. Cohnheim, an ardent worker on this subject, confirmed these experiments. He inoculated tubercular material into the eyes of rabbits, and was thus able to set up a local tuberculosis which gradually but surely became general.

The result of these experiments suggested that the disease was probably due to a micro-organism, and many looked for it but failed to find it, until Koch by his classical experiments and new methods of staining was able to demonstrate to the Physiological Society at Berlin, in 1882, the bacillus which he argued was the *vera causa* of tuberculosis.

Cohnheim now knew, as he had long suspected, that tuberculosis was a specific disease, and he greeted the new discovery with these words:—

“I have seldom in all my life felt greater pleasure than at the reception of this news.” Koch’s arguments were so conclusive at that meeting that no one ever tried to combat his statement, and he concluded that memorable communication thus:—“We can with good reason say that the tubercle bacillus is not simply one cause of tuberculosis, but its sole cause, and that without tubercle bacilli you would have no tuberculosis.”

Since Koch’s discovery the bacillus has been cultivated outside the body, injected into rabbits and guinea pigs, producing the disease, and there discoverable in the animals so inoculated, conclusive proof that bacillus is the *vera causa* of tuberculosis, as Koch said.

Wherever these bacilli are found, no matter what animal they occur in, there the disease tuberculosis is present. They may differ a little in the different animals, but they are practically the same, though the bovine is more virulent than the human.

They are very minute organisms, about $\frac{1}{8000}$ to $\frac{1}{12000}$ of an inch in length, consisting of a delicate sheath with numerous ovoid granules. These are the spores which do not take up the staining matter, hence we get the spore bearing bacillus presenting a beaded appearance. For the most part they are

slightly bent or even curved. They may occur singly or in pairs, or even in close-packed masses. They are recognised easily by their size under the microscope, and also by their behaviour with certain staining re-agents. They are not discoloured by a 25% solution of sulphuric acid after staining with fuchsin. They multiply by fission as well as by spores, are non-motile, and found in greatest numbers just where the disease is spreading.

Besides being found in the tissues, they are abundant in the sputum of consumptive patients, as well as in the blood and urine.

They can be cultivated outside the body either on blood serum or glycerine agar—agar jelly at a temperature between 95° F. to 105° F. They form little colonies in 10 to 14 days, differing greatly in this respect from the bacillus of diphtheria, which will grow almost in as many hours.

A high or a low temperature will stop their growth, but the bacillus as well as the spores are very resistant against complete destruction. Though a certain amount of moisture is necessary for their growth, they can be dried without losing the power of infection.

Tubercular matter taken from the lungs of persons buried for years has been found virulent on inoculation. Cold does not seem to kill the bacillus, but growth ceases at a temperature of 82° F.

Heat at 250° F. destroys them, so will a temperature of 107·5° F. continued for several weeks.

The spores retain their virulence under conditions which are inimical to the bacillus, and the chief source of infection is by the spores floating about in the atmosphere.

What are then the modes of entrance by which the infecting bacillus may gain entrance into the body?

(1.) By the respiratory and (2) alimentary tract. (3.) By inoculation. (4.) Another mode of infection—hereditary transmission—will be considered as we go on. The channel of infection often determines the seat of the disease.

(1.) **AERIAL INFECTION THROUGH THE RESPIRATORY TRACT.**
—In our ordinary surroundings of life the conditions necessary for the multiplication of the bacillus are never present, and we could only have tuberculosis by infection from one individual to another were it not for the fact already mentioned that the bacilli and their spores retain their vitality and virulence for a long time outside the body. In order that the virus may enter the lungs by the inspired air, the medium on which the micro-organisms develop must dry up and disintegrate into powder or dust. If it be remembered that the sputum of tubercular persons usually furnish the

richest supply of bacilli and their spores, and if it be borne in mind how carelessly this dangerous matter is treated, how it is scattered about the streets, the workrooms, the office floors, aye, and even the bedrooms, a source of infection will be found so great that none other need hardly be looked for.

One gets an idea of the virulence of this expectoration when we know that it retained its infective power six weeks, although kept moist and putrefaction had set in.

If the sputum was dried, on the other hand, it was found virulent by experiments on guinea pigs six months after being coughed up when kept from the action of the air.

Intermittent freezing and melting *does* not interfere with the power of transmitting the disease. It must not be supposed, however, that these tubercle bacilli are scattered about us without any choice or difference, but rather that they are principally found in narrow circumscribed regions, the centre of which is a tubercular person.

Ransome and Williams have been able to demonstrate the bacillus from air collected in the ventilating shaft of the Brompton Consumption Hospital, and inoculation experiments from the dust collected on the floor of this hospital have proved the infection to be present in the form of spores when the microscope had failed to show the bacillus.

Klein kept some guinea pigs in the ventilating shaft of the same hospital and they contracted the disease also.

Dr. George Cornet, in Germany, has found the bacillus in the dust of the street, but he points out a further source of infection from the handkerchief used by the consumptive. Here the sputum gets dried after repeated usage, and he has been able to get the bacilli from the bedclothes on which the handkerchief had lain during the night.

Strange to say, that although the walls in hospital wards where consumptives are kept have been found to be infected, other patients who may be suffering from some acute affection of lungs are still accommodated in many hospitals in the same wards as the consumptives.

Not only through the sputum may the air become infected, but also by the breath of the patient. When bacilli are given off by the breath they gradually sink, being heavier than the air, and as the temperature of the air is rarely sufficiently high to maintain their vitality active infection is not carried far in this way. There is nevertheless a great risk in the immediate inhaling of the breath of a consumptive, as might occur to anyone sleeping with an invalid.

(2.) INFECTION BY THE ALIMENTARY CANAL is perhaps the second most important mode of infection, and the disease in

this way may be communicated by means of milk or meat from diseased animals.

(a) MILK.—Doubt no longer exists about milk from tubercular cows being the means of conveying tuberculosis, particularly to infants and young children. Tubercular disease of the intestines and glands is almost peculiar to children, though we sometimes get it in adults as a secondary infection from swallowing their own sputum.

In such cases as these the gastric juice is weak and the bacilli are then particularly active. Infection may begin at the glands of the neck, or it may be a general infection or extend only into the glands of the abdomen.

Woodhead estimates that 79 per cent. of children dying of tubercular disease contract it in the mesenteric glands. Further, that it is most prevalent amongst children when milk forms the principal article of their diet.

Gerlach and Chauveau were the first to show that animals fed on the milk from tuberculous cows contracted the disease. Authorities are agreed that where there is a generalised tuberculosis, or where the udder is affected, the milk is highly infective, but they are not agreed as to whether the milk may be infective in cases of local tubercular disease where the udder is healthy.

Bang, Bollinger, and Hirschberger believe that the disease may be communicated by milk from tubercular cows even if the udder is not affected. These observers have been able to produce the disease by inoculation and by feeding experiments with milk from a tubercular cow with a healthy udder, and Woodhead and McFadjean were also able to produce positive results in a very small percentage of cases; but while the negative results are the rule, nearly every observer has been able to get some positive evidence.

Klern* states “the feeding of calves with milk derived from an udder containing tubercular deposits produced tuberculosis in these calves, but milk coming from a healthy udder (though the cow had tubercles in the lungs) fails to produce tubercles.”

The experimental researches for the recent Royal Commission seem to show that udder disease must be present before the milk is infective. Milk given or inoculated into rabbits and guinea pigs did not produce the disease when the udder was not affected, though the cow had advanced tuberculosis. Still, in view of the positive results obtained by different observers by the feeding of animals with milk from tubercular cows in which there was no udder disease, it would be much better

* Pathology of Infectious Diseases.

not to allow the milk of tubercular cows to be consumed, as there is an element of danger.

The presence or absence of the bacillus does not help us to say whether the milk is infective or not. Hirschberger has been able to produce the disease by introperitoneal injection when no bacilli were present in the milk, and from this he infers the infection was present in the form of spores.

Woodhead and McFadjean examined 600 cows in Edinburgh and found 37 of them tubercular, but got the bacillus in the milk of only six of them.

And the experiments made for the recent Royal Commission show that in tubercular affections of the udder the bacillus was invariably present, and animals fed or inoculated with the milk contracted tuberculosis.

Dr. Sydney Martin's report is as follows:—"Five tuberculous cows with udder disease found *post mortem* to be of tuberculous nature; bacilli were found in milk of three. Fifteen (15) test animals fed and thirteen (13) inoculated with the milk of these three cows all acquired the disease. Of the other two cows the milk (in which no bacilli were found) from one produced tuberculosis in four out of ten test animals fed on it, and when inoculated in six other animals produced tuberculosis in all. The milk of the fifth cow did not produce tuberculosis in two animals to which it was given as food, but did produce tuberculosis in two other animals when it was inoculated."

If bacilli cannot be found in the milk then the only test is inoculation, and this means the employment of a skilled inspector.

(b.) MEAT.—The danger of contracting tuberculosis from meat is not so great as the taking of milk from tuberculous cows, but it is nevertheless a source of infection if meat is not properly cooked.

When the disease is localised it is thought by some that there is little risk of eating the part of the carcass unaffected, but Professor McCall, of Glasgow, has shown that the bacilli, although not having their habitat in the blood, have been found there as well as in the marrow of bones. The authorities in Glasgow, acting on this, condemn the whole carcass. The Congress in Paris affirmed the necessity of these stringent measures, and many cities followed the example of Glasgow.

Klein is also of opinion that, inasmuch as the tubercular virus gets disseminated through the blood, any organ may at any time become infected with the virus—which is in transit. The organ need not contain any discernible tubercular deposit.

Woodhead was able to produce the disease in two rabbits by inoculating the raw juice from the rib muscles of a diseased cow where the tuberculous pleura had been stripped off by the butcher, but when he used the juice from the thigh muscles of the same cow he was not able to produce tuberculosis. He, therefore, shows that the parts in close proximity to the disease may be contaminated while the parts at a distance may not.

Bollinger and others found the juice expressed from the muscular tissue non-infective in 51 out of 58 carcasses examined, and in these cases the lesions present were very extensive.

Dr. Martin's experiments show that in generalised tuberculosis the meat is dangerous, and in local tuberculosis the meat may be contaminated by the butcher's knife.

Still the Commissioners "are prepared to believe that if sufficient discrimination and care were exercised in taking meat from tuberculous cattle, a great deal of meat from them might without danger be consumed by the community." This recommendation is more in touch with the general belief that now exists—that the measures adopted by the Glasgow and Paris authorities are altogether too stringent.

In Germany it is not usual to condemn meat where there is only one organ affected if the animal is not emaciated, but if the animal is emaciated the flesh is held to be injurious.

3. INOCULATION.—This is fortunately not a very common mode of infection. It has followed from a cut on the finger with a broken spittoon used by a phthisical patient. Medical men doing *post mortems*, butchers, and cooks have been infected, in the execution of their duties, in this way. It is said to have resulted in two cases from tattooing where the saliva of a phthisical patient was used.* It has occurred in Jews after the rite of circumcision being performed by an infected priest. In these inoculations there is generally nothing but a local tuberculosis set up, which ends in a suppuration, no permanent bad result following. Although rare in man, it is the general method of infection in experimenting with the lower animals.

4. HEREDITY.—The question whether tuberculosis can be transmitted from parent to child is one which authorities are divided upon. Many observers hold that the disease cannot be transmitted but only a predisposition, and heredity to such as Virchow and Frankel only means greater predisposition, but to others it means the actual transmission of the disease. It is, however, a fact that amongst some of the

* British Medical Journal, June 1st, 1895.

lower animals, as rabbits and guinea pigs, the disease may be transmitted, as was shown by the experiments of Berheim and others, and laid before the second Congress on Tuberculosis in Paris, 1891. It has seldom been found in calves, and rarely in new born infants.

While tuberculosis in some forms may be transmitted directly from parent to child, there is a very strong consensus of opinion that the form which affects the lungs is never so transmitted. But even in these cases, those who believe strongly in heredity will tell you that the germ has been in the system in a latent condition, while the tissues have been active, only asserting itself when the tissues have become more matured. But is the prevalence of consumption at this time not more likely to be due to the result of taking one's place in the world and being exposed to additional risks in the workroom, the office, etc.? It may then be taken for granted that "Consumption" is not hereditary, but only a predisposition; what that predisposition is we cannot yet say. Dr. Springthorpe, who has devoted a very large amount of study to this subject, speaking at the Medical Congress in Dunedin this year, defined it as "a bacterio-chemical question, affecting the strength of cells and serum in the struggle for existence with the invading microbe."

One thing seems certain, without this constitutional want of resistance the microbe is unable to invade and thrive in the tissues. This inherited tendency may be intensified, or it may be removed, but it will not, however intense in itself, cause the disease; the germ must be present. In the removing of this tendency lies the opportunity of preventive medicine, for there is usually ample time to correct this inherited tendency by careful attention to developmental requirements before "consumption" sets in.

Admitting then that heredity stands in rare cases as a channel of infection in some forms of tuberculosis, but in the majority of instances as only a predisposing cause, we now pass on to consider other circumstances which act as purely predisposing causes.

PREDISPOSING CAUSES.—Certain conditions such as dampness of soil, impurity of atmosphere, are important factors in the ætiology of tuberculosis.

1. **DAMPNESS OF SOIL.**—Dr. Buchanan and Sir John Simon have long since proved that "the drying of soil which has in most cases accompanied the laying of main sewers in the improved towns has led to the diminution more or less considerable of phthisis. They go on to quote certain cities where such improvements have been made and with what effect on the mortality of phthisis. They take 13 cities in

all, and the percentage of reduction from previous rates ranges from 49 in Salisbury to 47 in Ely, 43 in Rugby, 17 Croydon and Cardiff, to 11 in Merthyr, the lowest of the 13.

“It will be seen that the reduction of phthisis mortality where certain works have been executed is far too large and far too general to be regarded as an accidental coincidence. And the fact that in some of these cases the diminished fatality of phthisis is by far the largest amendment, if not the only one, which has taken place in the local health becomes extremely interesting and significant when the circumstances are remembered, that works of sewerage, by which the drying of the soil is effected, must always of necessity precede the accomplishment of other objects (house drainage, abolition of cesspits, etc.) on which the cessation of various other diseases is dependent.”

Dr. Bowditch, working independently and without any knowledge of Dr. Buchanan's experiments, arrived at the same conclusions as regards the mortality in America.

The remarkable freedom from consumption in some of the drier countries, such as Egypt, Cape of Good Hope, as compared with moist Britain, leads one to the same conclusion.

Dr. Andrews, of Chicago, inquiring into the mortality of consumption, came to the conclusion that it is the greatest nearest the sea board, and diminishes as we pass inland. He found that in Massachusetts 25 per cent. of all deaths were due to phthisis; in New York, 20 per cent.; in Kansas, 8 per cent.; in Utah, 6 per cent.; in California, 14 per cent.; but here we are again nearing the Pacific.

Taken from North to South, the same observer found that in Michigan the death rate was 16 per cent.; in Indiana, 14 per cent.; in Tennessee, 12 per cent.; in Alabama, 6 per cent. We may therefore consider that dampness of soil and sea-board towns are favourable predisposing agents of tubercular disease. It would seem as if the bacilli were there in greatest numbers, and most deadly in effects. Localities with dry soils and uniform temperature are least affected.

2. POLLUTION OF ATMOSPHERE.—Nothing tends to predispose to tuberculosis so much as vitiated atmosphere. This is evidenced by the fact that we have consumption most common in large cities; not only so, but in the parts of them where overcrowding and bad ventilation is at a maximum the mortality is highest. If you compare the death rate in the army now with what it was 50 years ago you will see the effect of good and bad ventilation. From 1830 to 1846 the mean annual mortality from phthisis per 1,000 troops on home service was 7·86. It was greatest in the Foot Guards, 11·9; and lowest in the Household Cavalry, 6·28; and the only

reason that could be given for this great difference was that the barracks of the Foot Guards were badly ventilated. From 1858 to 1884 the average annual death rate (for 26 years) was 2·5 per 1,000 strength, and in the year 1888 it was 1·20, a great reduction from 7·86.

In Parkes' Hygiene we are told that in the third ventilated prison at Leopoldstadt, in Vienna, during the years 1843 to 1847, no fewer than 51 per 1,000 deaths were due to phthisis, while in the well-ventilated House of Correction in the same city, for years 1850 to 1854, the deaths from phthisis were 8 per 1,000.

Dr. Russell, of Glasgow, shows not only the effect of overcrowding on the total death rate, but also the great effect it has on the death rate from consumption. He divided the city into nine districts; in two districts there was an average of one and a half persons to each room, and in these districts the death rate was 16·7 per 1,000. In seven districts there was an average of two and a half persons to each room, and here the death rate was 30·7 per 1,000. Coming to lung disease, and principally phthisis, he shows the death rate in the first two districts to be 5·10; in the remaining 7 districts it was 11·38 (or more than double) per 1,000 living.

Wherever, then, we have overcrowding and bad ventilation, whether in our dwellings, workrooms, or office, we expect to find the future victims of consumption.

I have been speaking to you principally of foul atmosphere, arising from defective ventilation, due chiefly to the accumulation in the air of the air products of respiration, of exhalation from the human body, as well as the pollution of the atmosphere from the accumulations of filth, refuse, and other putrefying waste, but there are other impurities which tell on the mortality of phthisis besides these from organic vapours, namely, those from trades of different kinds. Just as there are many kinds of impurities, so we recognise many kinds of consumptions. We have the "knife grinder's" phthisis in Sheffield and Birmingham, then we have the "stonemason's" consumption, "weaver's" consumption, etc.

All trades which give rise to dust predispose, and particularly where metallic dust is floating about, to phthisis. Knife grinders, file makers, cutlers, and stonecutters are at the top of the list, while fishermen, agriculturists, and coal miners are the most exempt.

The inhaled dust in these cases simply acts in a mechanical manner by injuring the mucous membrane of the lungs, and thus favours the conditions for the growth of the bacillus should it be inhaled.

It need not be wondered at then that those who work at trades where the air is loaded with dust containing metallic particles should be more liable to phthisis than those who work in rooms where animal or vegetable dust is present.

3. OTHER PREDISPOSING CAUSES.—Of other predisposing causes I need only mention improper food, in the case of infants especially, alcohol in excess, debilitating disease of any kind. In brief, it may be said that whatever reduces the vitality or resisting power of the body increases the susceptibility of the individual to tuberculosis.

PREVENTION OF TUBERCULOSIS.—How do we hope to prevent it ?

1. By diminishing the sources of infection—through the air, milk, and meat—preventing the spread of the bacilli outside the body.
2. By increasing the resisting power of those who are most exposed to danger.

In carrying out the first our attention must be directed to sputum, because in this we have the most fruitful source of danger. The consumptive should be instructed not to spit anywhere except in a spittoon, in which there is a quantity of disinfectant, say a 10 per cent. carbolic acid solution. They should be strongly warned against spitting on carpets, floors of workrooms, offices, and streets.

Patients who do not care to carry a flask-shaped spittoon with them ought to use pieces of linen instead of handkerchiefs, which could be burned as soon as finished with.

Expectoration from all phthisical patients ought to be burned. Many people will tell you that the sputum in the street does not harm because the sunlight destroys the bacilli. I grant you the sun is one of the best natural disinfectants we possess, but the spores of the tubercular bacilli are very resistant, and they are not always exposed to the sun. Apart from the habit of expectorating on the streets being a filthy one, it is the greatest source of infection. What is required is that consumptives should be told of the danger they may be to others if they are careless in this matter.

Consumption does not spread through the virulence of its infecting agent, but rather because people are ignorant of its cause and mode of extension.

Hidden dangers are most to be dreaded, and it seems to me absolutely necessary that the people should be taught and able to appreciate the risk of this mode of infection.

From the working of Cornet the Germans have come to the conclusion that cleanliness is what is needed, and they have

adopted a system of public spittoons, and patients are requested not to spit anywhere else except in these receptacles.

The New York Board of Health has also a system of spittoons in their public buildings, railway stations, and other public institutions.

These spittoons are made of porcelain, and can be washed in boiling water and disinfected. Others are made portable of porcelain or glass and carried about by patients.

So much for the destroying of the expectoration.

But the respired air of the patient may also be dangerous by its immediate inhalation. We should avoid being too closely shut in with consumptives, hence it follows no one should sleep in the same room. Consumptives' rooms should always be well ventilated—such patients are not only more comfortable but their health is much better.

Should the patients die or be removed the room and everything in it ought to be disinfected. While cleaning operations are going on the floors and walls should be kept moist so as to prevent dust from flying about and with it the bacteria.

Curtains, bedding, and clothing should be boiled, blankets steamed, and all other furniture cleaned and disinfected.

Paper on the walls should be stripped off and burned and the walls washed with CHLORINATED LIME, the only disinfectant Ransome and Delepine have found to be effective. Ordinary fumigations by chlorine, euchlorine, and sulphurous acid are useless even in the hands of experienced fumigators.

In intestinal and other forms of tuberculosis all excretions ought to be disinfected with 10 per cent. carbolic acid solution, which is more effective for this purpose, according to Fischer, than corrosive sublimate solution (1 in 500) equal parts.

These are all minute details, but a strict adherence to * them has reduced the mortality in the Grand Duchy of Baden by no less than .28 per 1,000 living. In 1882 the death rate there was 3.08. In 1887, it was after these precautions had been taken, 2.80 per 1,000 living. This seemingly small reduction, if applied to the United Kingdom, would mean an annual saving of life from consumption of 10,000 people.

At San Remo—a favourite residence for consumptives—all these precautions are carried out, and at the end of the season all public rooms and sleeping apartments are cleaned and disinfected.

*Sims Woodhead : Bacteria and their Products, p. 221.

It seems to be the time is fast approaching when tuberculosis will have to come under the notice of public health authorities.

Many argue that it must come under the Compulsory Notification Diseases Act and be treated as any other of the infectious diseases.

I confess this appeals very strongly to one, but there are many difficulties in the way of notification. For instance, we know that many consumptives are continually changing their residence, and often, in the hope of being cured, their medical attendant. Are we then to have a report from each medical attendant, and will the patients be required to notify any change of residence?

In New York the Board of Health has formed certain regulations for its prevention. They sent a circular to all medical men stating that the Board had resolved—

1. To register all subjects suffering from tuberculosis so far as they could gather from the physicians in attendance.
2. To send inspectors, unless requested by the doctor attending not to do so, to instruct patients and their families how to guard against the spread of the disease.
3. To disinfect all premises either vacated by removal or by death of patients without any charge to owner.
4. To make bacteriological examinations for physicians and to report to physicians sending specimens free of charge.
5. To require authorities of public institutions to report all cases within seven days.

I am not aware that any other country has taken up this matter so strongly as the New York Board of Health, but in Victoria the Australian Health Society, at the instigation of Dr. Springthorpe, has issued printed slips, entitled "How to prevent the spread of consumption," to all medical men for distribution amongst their patients.

The recent Medical Congress at Dunedin passed a resolution recommending for the use of medical men in their routine treatment of phthisical patients the "Table of Advice" originally drawn up by the Australian Health Society. I have in a report to our Government advised that the Central Board of Health might get this Table of Advice printed and distribute it.

While I believe sanitary authorities could do much in the way of disinfecting houses and rooms where consumptives

die, I feel our best efforts will be of little avail unless we can get the assistance not only of the medical profession, but of the individual members of the community, and we can only hope for this aid by educating the people as to the cause and nature of this disease, and the measures which will prevent it. Let it be known further that it is not only preventable but a curable disease, and I feel confident that with increased knowledge of the nature of tuberculosis we will have a greater effort made by the community which will doubtless diminish its prevalence to a great extent.

MILK AND MEAT INFECTION.—It has been stated that about 5 per cent. of all milch cows are affected with tuberculosis, and it is further estimated that about 16 per cent. of all cattle slaughtered in England and Germany are tubercular. It is stated to be as prevalent in Australia as in England. I am glad to say that it does not exist in Tasmania, or if it does it is very rare.

It follows from what I have already told you that milk from tubercular cows must never be used, because there is risk even if the udder is not affected that the milk may be tainted. No tubercular cow should be allowed to remain in the dairy, because if the udder is not already affected it may become so at any time, and the extreme difficulty of recognising it in the earlier stages warrants the removal of the cow at once.

Boiling will get rid of any danger, and it is a good rule to boil all milk, as it will destroy the germs of other diseases as well as of tuberculosis.

But we must go further and prevent, if possible, the supply of such milk, and, of course, this means that all dairies must be registered and be inspected at regular intervals by a competent inspector.

The recommendations of the Royal Commission went further ; the Commissioners advise “wherever any udder disease the cow must be isolated at once, the milk being considered highly dangerous, until the inspector has proved the presence or absence of tuberculosis.”

Meat is not such a dangerous mode of infection as contaminated milk. Nevertheless it is, as I have explained already, a source of danger, and calls for a rigid inspection of all meat before and after killing.

Dr. Martin’s recommendations to the Royal Commission were that the “slaughtering and dressing of all animals ought to be done under skilled supervision, with the object of securing the removal and destruction of every part of the carcase that contained any tubercle whatever, and also the destruction of the whole carcase where the animal is found

to have advanced or general tuberculosis. He sees no objection to the sale of meat-substances from carcasses which have shown only localised tuberculosis, and from which every particle of tubercle had been skilfully removed, provided always that in every subsequent process of preparing the meat for sale, due care be taken to guard the saleable portions from contamination by tuberculous matter."

"Total seizure," you see, is not advised as adopted in Glasgow and some other towns in the old country. The French Government, since the Congress, have decreed against it, Germany, and many other countries have considered it altogether too heroic a measure. That the bacilli may be found in the muscle and muscle juice, as well as in the blood of animals dying of a *generalised tuberculosis*, is proved by McCall, Bollinger, and others, but are they found in these structures in animals where there is only a *localised tuberculosis*? Those who oppose "total seizure" say no, and further tell us that we must not forget that it is not tubercular material we are eating, but cooked meat, which has all the appearances of being healthy, derived from an animal which had merely a localised tuberculosis.

To sum up this: in all cases where the disease is general, or more than one organ affected, the whole carcass should be condemned; where the tuberculosis is local, confined to one organ and the animal in good condition, the meat may be "passed," provided the organs are carefully removed and that the meat is not contaminated by the butcher's knife in dressing the animal.

All this goes to show the necessity of a proper inspection of animals before and after killing, and to do this we must insist upon all animals being slaughtered at public abattoirs. Any doubtful ones can be set aside to be tested with the tuberculin. The Intercolonial Medical Congress of 1896, in Dunedin, adopted the following resolution after a wide discussion on the subject of tuberculosis:—"That, recognising the serious extent to which tubercular disease prevails throughout Australasia, the fact that the disease is an infectious one, spreading through the medium of infected milk, meat, and air, this Congress begs respectfully to bring under the notice of the Governments of the different colonies the necessity which exists for the continuous and skilled inspection, veterinary as well as medical, of cattle and dairy stock, dairies, milk shops, abattoirs; and for the proper disinfection of public spittoons, conveyances, buildings, etc., known or suspected to have become infected. The Congress also strongly urges the general use of tuberculin as a test for the presence of tubercular disease in dairy and other stock."

These measures will require to be aided by the thorough

cooking of all meat. It has been shown by Woodhead that boiling is the most effectual way of destroying germs in meat, next baking in the oven, and the least effectual way is roasting.

While we thus prevent its transmission from animals to man through our milk and meat supply, we must not forget that if we would get rid of this disease altogether we must go farther and see if we cannot exterminate it in cattle. Many believe that with the assistance of the State—and it is purely a matter for the State to deal with—that we can. How is it to be done? By the compulsory testing with tuberculin and slaughtering of every animal affected with tuberculosis, with or without compensation to the owners, as the State may think fit.

TUBERCULIN.—You remember a few years ago great excitement prevailed over what was supposed to be a cure for consumption, and how that excitement gave place to bitter disappointment.

It consisted in injecting a small quantity of a glycerine extract of pure cultivation of tubercular bacilli which Koch called tuberculin.

Now although tuberculin has not proved to be a curative agent, it is one of the most valuable diagnostic tests we have.

Any animal—whether in the dairy, abattoir, or amongst the herd—suspected can be injected, and if you get a characteristic fibrile reaction, you may consider tuberculosis is present in that animal's system. It has been claimed by Dr. Springthorpe that he has been able to diagnose tuberculosis in the human subject in this way before there were any conclusive physical signs or before there was any sputum.

Veterinarians are now agreed that 97 per cent. of cases which give a reaction with tuberculin will on *post mortem* examination prove to be tubercular.

This, then, is the first step—power of diagnosis in cattle—in this great undertaking. The Government of Denmark has set aside £25,000 to be used by Professor Bang for the purpose of exterminating tuberculosis, if possible, in the cattle of that country. Whether he will be able to do so or not remains to be seen, but his efforts will be watched with more than ordinary interest by all interested in this subject.

In Canada and Germany the cattle are subjected to this test, and the German Government has voted £10,000 to assist in compensating owners.

The Central Board of Health, Sydney, has also instituted an examination on similar lines, and pays 30s. compensation to all owners for every tubercular animal slaughtered.

In New Zealand the Acting Government Veterinary Surgeon was in the early part of this year using it freely, and so satisfied was Mr. Park with the results that he stated at the Congress in Dunedin "that he was perfectly satisfied that with the tuberculin test he would eradicate tuberculosis from all dairies."

During the early part of the present year the French Minister of Agriculture proposed to bring up a Bill for the compulsory testing and slaughtering of all tubercular animals and for the partial compensation for all animals killed. It was estimated that this would cost £200,000 the first year. In Tasmania it is doubtful if we have any tubercular cattle, and it is the duty of the authorities to see that none are introduced. Stock imported for breeding purposes should therefore be carefully examined and tested with tuberculin. Compared with the other colonies, our death rate from phthisis is very low, in fact the second lowest on the list. Might not this very low death rate be attributed to the fact that our cattle are free from tubercular disease?

We must now direct our attention to the second measure by which we hope to prevent tuberculosis, namely, *by increasing the resisting power of the constitution*, avoiding everything that tends to reduce the vitality and increase the susceptibility of the individual.

This must be partly undertaken by the individual and partly by the State,

WHAT IS THEN THE DUTY OF THE INDIVIDUAL?—I must be brief, because the care and upbringing of those who are predisposed to this disease is a subject altogether too large for a paper such as this.

What I have to say applies not only to those who may be predisposed by inheritance, but also to those who may acquire it.

The question of marriage concerns us here. It is one of the most important questions affecting our social state, and yet few questions are less frequently entertained professionally. It would be a wise rule that no person with active consumption should marry, but the sacrifice is, perhaps, too great to be expected, nevertheless they should be warned of the risk they run of leaving children behind them which will be depending, it may be, on the charity of friends either for their care or support.

INFANCY.—No mother should nurse her infant if she is suffering from tuberculosis, as she may convey the infection directly or indirectly by kissing or through the breath. "It has been shown that tubercle bacilli may be present in the

mother's milk,"* and the large number of cases of tuberculosis in the alimentary tract and glands in infants would seem to confirm this evidence.

The further nursing of the infants, the rules to be carried out in the management of the nursery, the food of the child, the exercise, the amount of mental work and the general hygiene of the youth are all matters to be attended to by the parents, acting under the advice and counsel of the family physician.

But for the young adult who goes out to the world to fight his own battle and accept fresh responsibilities to which he is yet unaccustomed, a few words of warning may not be out of place.

The choosing of a profession, trade, or other occupation is one of the most important as well as his first duty.

Certain occupations predispose more readily than others. I have already mentioned that fishermen and others employed in outdoor avocations are most free, while those who work in close atmospheres with dusty occupation are mostly attacked with it.

It is, therefore, of the greatest importance to see that the occupation is suited to the health of the individual, and it may be stated as a general rule that outdoor employment is better than office or sedentary indoor work, and that a country life is better than the close atmosphere of town.

It is impossible that everyone of us can either live in the country or have outdoor employment. Many are a good deal confined during office hours, but there are few who could not have outdoor exercise during some part of the day. What that exercise will be depends very much upon individual taste, but for perfect health it is necessary that every organ should have a share of activity. Nothing must be indulged in that interferes with the expansion of the lungs; the very common exercise of bicycling is no doubt good, but the one great objection is the stooping position, which constricts the chest.

Walking, rowing, riding, outdoor games of different kinds are all very good, provided they are never carried to excess. It must never be carried to the point of fatigue, and taken when the weather permits. In the warm weather early morning or late afternoon are the best times, but during winter in the middle of the day we enjoy the sun most.

Clothing should be warm and light, equally distributed over the body; woollen material is therefore the best for

* J. E. Squire, M.D.: *The Hygienic Prevention of Consumption*, p. 59.

underclothing. It should fit loosely and in no way interfere with the free movements of limbs or chest. Sudden change of temperature must be guarded against.

Diet should be plain and nutritious, with a large quantity of milk and fatty food if possible. The meals should be taken at regular intervals.

Alcohol should be avoided as a general rule, in fact it ought not to be taken unless under the direction of the physician. It must always be remembered that intemperance increases the predisposition by lowering the disease resisting power of the constitution.

Where possible, it is well to choose a healthy site for one's residence. Those who are predisposed should especially be careful that the house is built on a porous soil or is well drained. Damp clay, retentive soils are risky unless well drained.

The air round about should be pure and have free movement. It is also important that there should be plenty of sunlight, but how many people try in every possible way to block out the sun by verandahs overhung with creepers, trees, etc.?

The height above the sea level is of great importance. Not only do we get purer air the higher we get up, but the respirations become deeper in the high altitudes. Height above sea level has a marked effect upon the disease phthisis, as by the following death rates in Baden and Switzerland* :—

Feet over Sea.	Baden.	Per 10,000 Deaths.	
		Switzerland.	Medium.
Less than 1,600	1,040	860	950
1,600 to 2,700	830	730	780
2,700 to 3,200	750	390	570
Over 3,200	860	500	680

As already pointed out, a moist, damp atmosphere is a predisposing agent, and most seaboard towns are unsuitable. The Medical Congress, already mentioned, adopted the following resolution, which bears out this statement :—"That this Congress expresses the opinion that it is unwise and cruel to recommend advanced cases of phthisis to seek Australasia as a health resort ; that, whilst there are many places in the different colonies of great climatic value in the earlier and curable stages, the coastal regions generally are to be regarded as unsuitable for almost all stages.

A dry air, with plenty of sunshine, even if the temperature is low, seems most suited provided always the diurnal range of temperature is not too great.

* Mulhall Dictionary of Statistics.

PREVENTION BY THE STATE.—Although the individual may do much to prevent consumption, the results of our efforts depend very largely upon the sanitary conditions of our neighbours. It is, therefore, the duty of the State to see that no one is allowed to suffer from disregard of hygienic rules of those around him.

I have already pointed to the danger of dampness of soil, and what effect the laying of sewers and consequent draining of the subsoil water had upon the mortality of phthisis. It should be made absolutely compulsory to drain before a permit is given by any Health Board to build a dwelling.

The dwelling itself should receive the greatest attention. Although it may be too late to get existing houses remedied, precautions ought to be taken to prevent all new houses being constructed the plans of which are not first approved of by the Board of Health, who should see that all precautions are taken against dampness, that sufficient sunlight and ventilation are provided for by means of window space, height of ceilings, etc.

Dr. Ransome has shown in his paper on "Tubercular Infective Areas" in certain streets and courts, consisting of back to back houses, unfurnished with thorough ventilation, tubercular disease was much more common than in other parts of the town.

Overcrowding of houses, without proper space between, the regulating of the height of houses as well as the widths of streets, are matters which must be attended to by the public health bodies of the State. We want not only a plentiful supply of air, but also a pure supply; cleanliness then must be insisted upon, everything that pollutes the atmosphere must be removed.

Overcrowding of inmates in our lodging houses, our shops, workrooms, or factories must be prevented. There is nothing so inimical to the life of bacteria as sunlight, and no disinfectant so cheap. There should therefore be plenty of sunlight and good ventilation. Every workroom ought to be licensed to hold a certain number of workers, the number being determined by the space as well as by the means of ventilation. Under the Women and Children Employment Act we have power of inspection, but no provision is made to fix a minimum amount of cubic space for each person.

Such, then, are a few matters that might well be attended to with good effect. While the health authorities may do much, the individual must assist if we would overcome this deadly enemy.

I feel confident that once the danger of consumption being infectious is fully appreciated by the people we will have greater efforts made to prevent it.

In conclusion, it may seem to some of you that I have painted a very black picture of tuberculosis and its dangers. Let me say if I have increased your knowledge I have not increased the danger, and all I would ask of you is to make use of your greater knowledge. For, let me tell you, by way of comfort, that tuberculosis is not only a preventable but a curable disease, and the agents which prevent go far towards curing. In the light of recent discoveries in serotherapeutics, I am hopeful that some specific serum will yet be found, and that instead of tuberculosis exterminating the human race the human race will exterminate it. But it was not of the cure of tuberculosis that I came to speak, but rather its prevention, and might I not conclude in this, as in many other instances,

“PREVENTION IS BETTER THAN CURE.”

DISCUSSION:

Dr. BRIGHT characterised the paper as a most able one. He agreed with almost everything Dr. Sprott had said, and did not know he had ever heard a paper calculated to be of better service to the community read at this society's rooms. He (the speaker) had been of opinion for 25 years that consumption was infectious. He had seen husbands taking it from wives, and wives from husbands, and he had always advised that a consumptive patient should occupy a separate room. Boiling the milk was most important. Dr. F. Swarbeck Hall strongly advised it in this city years ago. Much could be done by the efficient inspection of dairies and dairy cows. They had seen last summer what great dangers the health of the city was exposed to through bad and unwholesome milk being sold. The spread of infection by the sputum of diseased persons was a most serious thing. He believed very strongly that the disease was hereditary; that predisposition was not all that was communicated from parent to child. Tuberculosis was most common in aged milch cows. He moved a vote of thanks to Dr. Sprott, and hoped that the people would boil their milk, also that expectoration about the streets would be suppressed.

Dr. HARVEY seconded, and congratulated Dr. Sprott on the able way in which he had handled the subject. Another means of prevention was undoubtedly to be found in a reform in the manner of burying the dead. Spores of disease were often brought up by the earthworm.

Dr. CROSBY WALCH believed that the disease was not hereditary, but predisposition only was communicated from mother to child.

Mr. MAULT intimated that the Central Board of Health was seeking to obtain legislative power to inspect all dairies in the country sending milk into the city.

The CHIEF JUSTICE thought that if it be true that there was no tuberculosis in Tasmanian cattle, as Dr. Sprott had indicated, the colony must have a great advantage, and with the use of the tuberculine test in examining all stock brought to the colony for slaughter it might be kept out of our cattle and our meat.

The vote of thanks was passed with acclamation.

Dr. SPROTT, in replying, said it was generally conceded that consumption of the lungs was not hereditary, but tuberculosis was hereditary. So long as a person kept strong and in good health the bacilli of tuberculosis need not be feared. As to tuberculosis in stock in Tasmania, he had stated that he had not, so far, been able to find any.

SOME TASMANIAN FISHES.

BY J. DOUGLAS OGILBY.

(Communicated by Alexander Morton, Esq.)

Read May 28th, 1896.

Having occasion some time ago to compare certain Tasmanian fishes with their New South Wales representatives, I applied for assistance to Mr. Alexander Morton, Curator of the Tasmanian Museum, Hobart, who, with a commendable promptitude and liberality which, with advantage to Australian biology, might be well imitated, forwarded unreservedly a number of the required species, with the suggestion that I should embody the result of my researches in the form of a paper to the Royal Society.

The following remarks, the outcome of that suggestion, deal with a few of the more interesting fishes received from Mr. Morton, special attention having been given, as requested, to the *Mugilidæ*.

The earliest record of the occurrence of this family in Tasmanian waters is to be found in Sir John Richardson's second notice of the fishes collected at Port Arthur, and sent to England by Commissary-General F. J. Lempriere. In this paper, which appeared in 1840, a gray mullet is mentioned under the name *Dajaus* diemensis*, but without detailed description; in the following year, however, a very full and accurate diagnosis of the species appeared in the Transactions of the Zoological Society of London, and some years later both the Tasmanian and New Zealand species were figured by the same author in the Voyage of the Erebus and Terror as distinct fishes. Modern writers, with the exception of Castelnau and Macleay who follow him, are satisfied as to the identity of the two forms, and so we find Dr. Günther, in 1861, writing of them under the name of *Agonostoma forsteri*, he having quite unnecessarily changed the construction of Bennett's generic name, though, as remarked by Dr. Gill, he has retained this orthography in the fifth volume of his Catalogue of Fishes in the analogous names *Plecostomus*, *Chæstomus*, etc.

In 1842 the occurrence of the species on the Australian coast was noted for the first time by the Rev. Leonard Jenyns from a dried specimen collected at King George's Sound by Darwin during the Voyage of the Beagle, subsequent to which no record of it is to be met with, until in 1872 Count Castelnau records it as abundant on the coast of Victoria, reverting, as before mentioned, to Richardson's

* *Dajaus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* xi. p. 164, 1836; type, *Mugil monticola*, Bancroft = *Agonostomus monticola*.

name, and stating that the Tasmanian fish is distinct from the New Zealand one, but giving no reason for this opinion ; not content with this, he further subdivides the Australian form by separating from *diemensis* the common mullet of the Gippsland Lakes under the name of *Agonostoma lacustris*.

In Sir William Macleay's paper on the "*Mugilidae* of Australia,"† this is the only species of mullet recorded from Tasmania, from whence it is catalogued as *Agonostoma diemensis*, that author not only considering that its identity with the New Zealand fish had not been satisfactorily established, but also that Castelnau's *Agonostoma lacustris* from the Gippsland Lakes was worthy of specific recognition. With neither of these conclusions can I agree, for though the only New Zealand specimens which I have had an opportunity of examining were brought over in ice, sealed and cleaned for sale in Sydney, there is no doubt in my mind as to the correctness of Dr. Günther's judgment in referring Richardson's fish back to Forster's *albula*, while the two continental examples of *Agonostomus* which have passed through my hands, and which agree perfectly with Castelnau's *lacustris*, cannot be specifically separated from the Tasmanian fish.

Three years subsequent to the appearance of Sir William Macleay's catalogue, Mr. Robert M. Johnston published a "Catalogue of the Fishes of Tasmania,"‡ which included all the species of fishes at that time known to occur within the limits of the Tasmanian fauna. This list was chiefly based on Dr. Günther's well known British Museum Catalogue of Fishes and Macleay's recently published Australian Catalogue, largely supplemented by its author's close study of the fishes of the colony during a period of six years. Mr. Johnston had also the advantage of being in a position to consult Mr. Morton Allport's MS. list, but, like myself, he does not appear to have seen, or even known of, Dr. Bleeker's paper on the "Fishes of Van Diemen's Land."

In Mr. Johnston's catalogue we find the first published§ announcement of the occurrence of a second Mugilid, the two species being recorded (pp. 122, 123) as follows :—

83. *Mugil cephalotus*, Cuv. and Val. *Sand mullet*.

84. *Agonostoma forsteri*, Bl. *Sea mullet*.

A short account, under the above names, of the distribution, habits, mode of capture, etc., of both species will be found on pp. 86 and 87 of the same paper in the chapter devoted to the marine food fishes.

† Published May, 1880.

‡ Proc. Roy. Soc. Tas. 1882, pp. 53-144.

§ Allport had previously included the species, but I am unable to say under what name.

At p. 57, however, in the chapter headed "Market Fish and Fisheries," section ii., "Middle Ground" Fisheries, Mr. Johnston gives to what is certainly intended for the same fish its correct name of *Mugil dobula*, and as no explanation of the subsequent change of name to *cephalotus* is given, I am somewhat at a loss to know whether or not he considers Günther's *dobula* to be inseparable from Forskal's *oeur*¶, or whether the former name is merely due to a *lapsus calami*; the two species are quite distinct.

In 1891 a revised list* by the same author appeared, in which these two species—*Mugil cephalotus* and *Agonostoma forsteri*—again figure as the sole representatives of the Tasmanian *Mugilidæ*, but with the substitution in the latter of "Estuary Mullet" as a trivial name in place of "Sea Mullet"; the amended name is much the more suitable, as the fish, on our coasts at any rate, is principally an inhabitant of brackish water.

Mr. R. Sherrin, however, in his "Handbook of New Zealand Fishes," p. 65, quoting Dr. Hector, writes in reference to the confusion in the popular mind between this fish and the herring. "It is easily recognised from the true herring by having two fins on the back, the first of which has only four rays. I particularly mention this, as in some years what is supposed to be this fish *visits the coasts in enormous shoals*,† like the herring of the British seas." I give this quotation because the habit here alluded to is totally opposed to all that we know of its life history in Tasmanian and Australian waters, and indeed of the habits of the other members of the genus, which are without exception denizens of fresh or brackish waters, and, if correct, must be taken into consideration as a factor of some importance as regarding the claims to specific separation put forward by some writers on behalf of the Tasmanian fish. It is probable, however, that this alleged difference in habit is traceable to the confusion between the mullets and herrings, the words "*visits the coasts in enormous shoals*" being as indisputably true of the latter as it is probably incorrect of the former fish. This solution of the difficulty appears to have commended itself to Dr. Hector as well as to myself, else he would hardly have penned the words "what is supposed to be this fish."

Continuing the same quotation, Mr. Sherrin writes:—"The Picton Herring, a dried fish commonly known through-

¶ *Mugillour*, Forsk. Descr. Anim. p. 14, 1775 = *Mugil cephalotus*, Cuv. and Val. H. N. Poiss. xi. p. 110, 1836.

* Proc. Roy. Soc. Tas. 1890, pp. 26-34.

† The italics are mine.

out the colony, is the 'aau,† preserved by smoking." On p. 72, however, Mr. Sherrin, alluding to the Australian Pilchard, writes:—"In the beginning of April they appear in Queen Charlotte's Sound, and are caught in large numbers, and converted by salting and smoking into the highly esteemed Picton Herring."

Taken together the two paragraphs quoted are directly contradictory of one another, or at the least so worded as to be liable to cause confusion in the minds of those who are not in a position to make a personal investigation; nevertheless I can affirm that both paragraphs are to some extent true, for having purchased in the Sydney market smoked "Picton Bloaters" and fresh "New Zealand Herrings," I found the former to be *Clupea sagax* and the latter *Agonostomus forsteri*.

The following epitome of the three¶ mugiloid genera so far recorded from Tasmania should make the task of distinguishing them easy, since up to the present time only one species of each genus has been recognised, though doubtless a more thorough investigation of the estuary fauna, especially in the northern and eastern districts, will reveal the presence of others.

Adipose eyelid present; an elongate scale in the axil of the pectoral; snout scaly.

Both jaws toothless; anal fin with eight soft rays
Mugil, p.

No adipose eyelid; no elongate scale in the axil of the pectoral; snout naked.

Teeth in the upper jaw only, in a single series; anal fin with nine soft rays. *Myxus*, p.

Teeth in both jaws, in several series; anal fin with twelve soft rays. *Agonostomus*, p.

In this and all subsequent papers the following rules for taking the comparative measurements will be strictly adhered to, unless special mention to the contrary shall be made:—The total length is the distance between the extremity of the jaws and the base of the caudal fin; the length of the head is the distance between the tip of the snout and the free margin of the bony opercle, or, if present, the tip of the opercular spine; the diameter of the eye is measured along its horizontal axis; the width of the interorbital region is the narrowest point of the cranium between the eyes; the base of a fin is the distance between its origin and the

† Aua and Makawhiti are names by which *Agonostomus forsteri* are known to the Maoris.

¶ Since this was written Mr. Morton has sent me a specimen of *Lisa peronii* from Tasmania; this genus may be distinguished from *Mugil* by the absence of an adipose eyelid, from *Myxus* and *Agonostomus* by the absence of teeth. It differs from all our other mullets in the great depth of the caudal peduncle.

insertion of the last ray ; the depth of the caudal peduncle is taken at its shallowest portion, and its length is the interspace between the dorsal and caudal fins. In giving the total length to which a fish attains the caudal fin is, as a matter of course, included.

Appended is a full generic and specific description of each of the Tasmanian Gray Mulletts taken, in the case of *Myxus* and *Agonostomus*, entirely from specimens forwarded by Mr. Morton, while that of *Mugil dobula* was of necessity drawn up from Port Jackson examples, both the Tasmanian specimens received having been unfortunately destroyed, not, however, before they had been carefully examined and compared with our common New South Wales Sea Mullet. One of the Tasmanian examples was in the adult, the other in the half-grown or "hardgut" stage.

MUGIL.

Mugil, Artedi, Gen. Pisc. p. 32, 1738.

Body oblong, somewhat compressed ; head moderate, the snout short and broad, not depressed ; mouth moderate and transverse, the lips thin ; premaxillaries narrow, protractile ; maxillary not bent downwards posteriorly, concealed except at the extreme tip beneath the preorbital, the lower border of which does not overlap it, without supplemental bone ; lower lip included, the dentary bones of the lower jaw obtusangular in front, separated at the symphysis by a shallow notch. Adipose eyelid present ; preorbital minutely denticulated, its lower border without notch ; opercular bones entire ; gill-rakers short, slender ; six branchiostegals ; pseudobranchiæ present ; jaws toothless, fringed with minute cilia ; vomer, palatines, and tongue without, pterygoids with a small group of minute teeth ; two dorsal fins with iv. i 8 rays, the origin of the first about midway between the base of the caudal and the extremity of the snout ; anal fin originating slightly in advance of and not more developed than the soft dorsal, with iii 8 rays ; ventrals moderate, rounded, with a rather feeble spine ; pectorals rather small, pointed, with 16 rays, the upper ones the longest, the second undivided and not stronger than the third ; caudal emarginate, with the lobes acute. Scales moderate, cycloid ; snout and preorbital scaly ; an enlarged scale in the axil of the pectoral ; a scaly process between the ventral fins.

Deriv.—*Mugil* ; the Latin name for a Mediterranean species, from *mulgeo*, to suck, in allusion to their method of procuring food.

Type.—*Mugil cephalus*, Linnæus.

MUGIL DOBULA.

Mugil dobula, Gnth. Catal. Fish, iii. p. 420, 1861 and Fisch. Sudsee, p. 214, pl. cxx. f. A. 1876; Casteln. Proc. Linn. Soc. N.S. Wales, 1878, iii. p. 387; Macl. Proc. Linn. Soc. N.S. Wales, 1880, iv. p. 415; Ogilby, Edi. Fish. N.S. Wales, p. 118, pl. xxxi. 1893. *Mugil waigiensis* (not Quoy Gaimard) Casteln. Proc. Zool. Soc. Vict. 1872, i. p. 140. *Mugil grandis*, Casteln. Proc. Linn. Soc. N.S. Wales, 1878, iii. p. 386; Macl. l.c. p. 412. *Mugil cephalotus* (not Cuv. Val.) Johnston, Proc. Roy. Soc. Tas. 1882, p. 122.

D. iv. i 8. A. iii 8. Sc. 40—42/14—15.

Length of head $3\frac{9}{10}$ to $4\frac{1}{10}$, depth of body $3\frac{3}{5}$ to $3\frac{9}{10}$ in the total length; width of head $1\frac{2}{5}$ to $1\frac{3}{5}$, of the interorbital region, which is almost flat 2 to $2\frac{1}{5}$, diameter of eye $3\frac{2}{5}$ to $4\frac{1}{5}$ in the length of the head; snout very broad and obtuse, as long as to one fourth of a diameter longer than the eye; maxillary longer than the diameter of the eye, reaching to or nearly to the vertical from its anterior margin; preorbital narrow, its distal end rounded and about half as wide as the pupil, entire or minutely serrated on the posterior portion of the lower and the hinder margins; 68 to 74 gill-rakers on the lower branch of the anterior arch; body rather stout, not much compressed, the dorsal profile but little convex, much less so than the ventral. The origin of the spinous dorsal is midway between the base of the caudal and the extremity of the snout; the spines are rather weak, the first slightly curved, as long as or a little longer than the second, its length $1\frac{3}{5}$ to 2 in that of the head; the third spine is considerably shorter than the second, while the fourth is from 2 to $2\frac{1}{2}$ in the length of the first; the space between the origins of the dorsal fins is as long as or a little longer than the head; the anterior soft rays are as long as or shorter than the first spine, and the outer border of the second dorsal is moderately emarginate, the last ray being considerably produced; the anal fin originates slightly in advance of and does not extend quite so far back as the second dorsal, its base being $1\frac{2}{5}$ to $1\frac{1}{2}$ in its distance from the caudal; the anterior soft rays are as long as those of the dorsal, and when laid back do not extend to the extremity of the last ray, which is more or less produced; the outer border of the fin is slightly emarginate; ventral inserted beneath the last third or fourth of the pectoral, its length $1\frac{1}{2}$ to $1\frac{3}{4}$ in that of the head, and $2\frac{1}{4}$ to $2\frac{1}{2}$ in the distance between its origin and the anal; the outer ray a little longer than the second; third, or third and fourth pectoral rays the longest, not extending to beneath the origin of the spinous dorsal, $1\frac{1}{3}$ to $1\frac{3}{5}$ in

the length of the head ; caudal deeply emarginate ; caudal peduncle rather short and stout, its least depth $2\frac{1}{4}$ to $2\frac{4}{5}$ in the depth of the body, and $1\frac{1}{4}$ to $1\frac{2}{5}$ in its length. The axillary scales of the pectoral and ventral largely developed, and about as long as those of the first dorsal, which extend half way along the terminal membrane ; a series of small scales between the anterior dorsal and anal rays. Steel blue above, the sides and lower surfaces silvery ; a small black spot in the axil of the pectoral, and a golden spot on the upper angle of the opercle ; dorsal and pectoral fins dark blue-grey, the latter with a large silvery iridescent blotch covering the lower two thirds of its base ; caudal and anal fins yellowish-green.

This fine mullet has a much wider range than the majority of our Australian species, for, in addition to its Tasmanian distribution, which, according to Messrs. Johnston and Morton, comprehends the northern and eastern coasts, it is in all probability an inhabitant of the entire sea-board of the continent. Owing to the want of local catalogues of the fishes occurring along our southern, western, and northern shores, we have to be satisfied with such meagre records as are to be found in isolated papers, and in most cases, therefore, the exact limit of the range of a species cannot be definitely ascertained ; in the case of this mullet, however, we have precise records of its abundance along the whole of our eastern and south-eastern coasts ; westward of Victoria a hiatus occurs until Perth is reached, from whence Dr. Günther, the author of the species, found examples in the British Museum collection. As Macleay obtained specimens at Port Darwin, it is safe to conclude that it is found at all intermediate stations between that locality and Perth on the one hand and Cape York on the other, and it would even appear to extend north-westwards right through the Malaysian seas to the coasts of China, if Professor Kner is correct in attributing to this species two mullets collected at Hong-kong during the voyage of the "Novara." Both these examples were, however, very young, the largest being only five centimeters, and it scarcely seems advisable to me to claim so great an extension of distribution on so slender a foundation as the differences between this and any closely allied species (such as *oeur*, which is a common Chinese fish) at so early a stage of growth. To the north-east there is, however, more definite information as to its range, Dr. Günther having recorded it both from the New Hebrides and the Sandwich Islands.

This species is *par excellence* the mullet of our eastern and south-eastern coasts, and to it assuredly should be limited the name "Sea Mullet," as typifying its habit of gathering

in enormous shoals off our coasts during the latter end of the summer, preparatory to seeking its spawning beds in the shallower parts of our bays and estuaries. In its adult state this is the name applied to it by the residents of New South Wales and Queensland, the immature fish, prior to its first visit to the open sea, being known in the southern colony by the name of "Hardgut Mullet," in the northern by the appropriate one of "Mangrove Mullet"; in Victoria and Tasmania it has somehow contracted the name of "Sand Mullet," a title which is by no means suitable, as during the short time when it is engaged in spawning it shows a decided preference for mud banks at the mouths of rivers over the more open sandy beaches, and the remainder of its life is passed out at sea. This fine species attains to a length of 650 millimeters, and a weight of ten pounds or even more.

As this mullet has been confused by Mr. Johnston and others with *Mugil oeur*, the following differences between the two fishes may appropriately be mentioned here. In *dobula* the head is proportionately smaller, the body deeper, the eye larger, the jaws are without trace of teeth, and the scales are cycloid. The two last characters serve by themselves to distinguish the two species, as in *oeur* the teeth are "distinct in both jaws" (Day, Fishes of India), and the "scales of the trunk are more regularly ctenoid" (Kner, Voyage "Novara").

The mistake has no doubt been partly caused by Macleay's assertion that Prof. Kner "announces it," i.e., *cephalotus*, "as a Port Jackson fish." This is quite incorrect; that author records specimens obtained by the collectors of the "Novara" from Java, Manilla, and New Holland, the latter term being used throughout the whole work as synonymous with Australia.

The most southerly latitude to which I can with any certainty refer *oeur* is that of the Mary River, Queensland, where it was obtained by the naturalists of the "Challenger." From the ctenoid character of the lepidosis and the presence of teeth I should judge that *Mugil oeur* was more habitually a denizen of fresh and brackish waters than *Mugil dobula*.

MYXUS.

Myxus, Günther, Catal. Fish. iii. p. 466, 1861.

Body oblong, compressed; head moderate, the snout pointed and somewhat depressed; mouth small and transverse, the lips thin; premaxillaries narrow, protractile; maxillary not bent downwards posteriorly, almost entirely hidden beneath the preorbital, which considerably overlaps it posteriorly, without supplemental bone; lower lip included, the dentary bones of the lower jaw obtusangular in front,

not separated by a notch at the symphysis. Adipose eyelid rudimentary ; preorbital denticulated, its lower border without conspicuous notch ; opercular bones entire ; gill-rakers moderate, slender ; six branchiostegals ; pseudobranchiæ present ; upper jaw with a single series of small club-shaped or crenulated teeth ; lower jaw with fine cilia ; vomer, palatines, pterygoids, and tongue with patches of minute teeth ; two dorsal fins, with iv. i 8 rays, the origin of the first nearer to the base of the caudal than to the extremity of the snout ; anal fin originating well in advance of and more developed than the second dorsal, with iii 9 rays ; ventrals moderate and rounded, with a rather feeble spine ; pectorals small, obtusely pointed, with 16 rays, the upper ones the longest, the second undivided and somewhat stronger than the third ; caudal emarginate, with the lobes acute ; scales moderate, mostly cycloid ; snout naked : preorbital scaly ; no enlarged scale in the axil of the pectoral ; a scaly process between the ventral fins.

Deriv.— $\mu\acute{\upsilon}\xi\omega\nu$ or $\mu\acute{\upsilon}\xi\omicron\varsigma$, a kind of fish, from $\mu\acute{\upsilon}\xi\alpha$, slime.

Type.—*Myxus elongatus*, Günther.

MYXUS ELONGATUS.

Myxus elongatus, Gnth. Catal. Fish iii. p. 466, 1861 ; Kner, Voy. Novara, Fisch. p. 230, 1869 ; Maccl. Proc. Linn. Soc. N.S. Wales, 1879, iv. p. 426 ; Ogilby, Rep. Lord Howe Isl. Fish. p. 63, 1889, and Edib. Fish N.S. Wales, p. 128, pl. xxxiii. 1893.

D. iv. i 8. A. iii 9. Sc. 42-46/14-15.

Length of head $3\frac{5}{6}$ to $4\frac{1}{10}$ depth of body $3\frac{7}{10}$ to 4 in the total length ; width of head $1\frac{7}{10}$ to $1\frac{9}{10}$, of the slightly convex interorbital region $2\frac{3}{4}$ to $2\frac{7}{8}$, diameter of eye 4 to $4\frac{2}{3}$ in the length of the head ; snout obtuse, from one fifth to two fifths of a diameter longer than the eye ; maxillary about as long as the diameter of the eye and not reaching to the vertical from its anterior margin ; distal end of the preorbital obliquely truncated, rarely rounded, as wide or nearly as wide as the pupil, the posterior half of the lower and the hinder borders strongly denticulated ; 60 to 64 gill-rakers on the lower branch of the anterior arch ; body moderately stout and deep, the dorsal profile slightly and evenly convex, less so than the ventral. The origin of the spinous dorsal is a little nearer to the base of the caudal than to the extremity of the snout ; the spines are rather weak, the first straight or nearly straight, very little longer than the second, its length 2 to $2\frac{1}{5}$ in that of the head ;

the third spine is considerably shorter than the second and the fourth, which is curved and feeble, is 2 to $2\frac{1}{3}$ in the length of the first; the space between the origins of the dorsal fins is as long as or a little shorter than the head; the anterior soft rays are as long as or a little longer than the first spine, and the outer border of the second dorsal is but little emarginate, the last ray not being appreciably produced; the anal fin originates well in advance of and does not extend quite so far back as the second dorsal, its base being $1\frac{1}{5}$ to $1\frac{2}{5}$ in its distance from the caudal; the anterior soft rays are longer than those of the dorsal, and when laid back extend to, or nearly to, the extremity of the last ray, which is but little produced; the outer border of the fin is moderately emarginate; ventral inserted beneath the last fourth of the pectoral, its length $1\frac{1}{2}$ to $1\frac{4}{5}$ in that of the head, and $2\frac{1}{2}$ to $2\frac{3}{4}$ in the distance between its origin and the anal; the outer ray not longer than the second; third pectoral ray the longest, not nearly extending to beneath the origin of the spinous dorsal, $1\frac{4}{9}$ to $1\frac{5}{9}$ in the length of the head; caudal deeply emarginate; caudal peduncle long and rather slender, its least depth $2\frac{1}{4}$ to $2\frac{1}{2}$ in the depth of the body and much less than its length. Scales of the cheeks, preorbitals, and ventral surface finely ciliated; the elongated scale in the axil of the ventral is much smaller than that at the base of the first dorsal, which reaches almost to the end of the membrane; a series of small scales between the soft dorsal and anal rays. Light reddish brown or dark green above, silver below, the sides pink; a small black spot in the axil of the pectoral; a golden spot on the opercle; soft dorsal generally with a median dusky band; extremity of the caudal fin blackish.

The aboriginal name of this fish in the Sydney district is Tallegalane, but it is more commonly sold by dealers as Sand Mullet, a name well in accordance with its habits. Its range extends from Southern Queensland to the coast of Victoria, whence Günther received one of his types. In that colony, however, it has either been overlooked or is a mere straggler, as it has not been recorded since; the fact that none of the Tasmanian authorities have ever noticed it, but that at the same time Mr. Morton was able to forward five examples, induces me to incline to the former theory. Its range on the coast of the island colony is not known, but probably concurs with that of *Mugil dobula*. The Tallegalane* attains a size of 400 millimeters, though those which come to market more ordinarily average less than twelve inches.

* Where the native name of an animal or plant is known it is, I think, always best to use it in preference to such names as "Sand Mullet," "Sea Mullet," etc., which are almost sure to be bandied about from one species to another in different localities.

AGONOSTOMUS.

Agonostomus, Bennett, Proc. Zool. Soc. 1830, p. 166 ; *Agonostoma*, Günther, Catal. Fish, iii. p. 461, 1861, *et auctt.*

Body elongate-oblong, strongly compressed ; head moderate, the snout somewhat pointed and depressed ; mouth moderate and sublateral, the lips thin ; premaxillaries narrow, protractile ; maxillary straight, not bent downwards posteriorly, extending beyond the lower margin of the preorbital and entirely hidden beneath it and the anterior bones of the sub-orbital ring, without supplemental bone ; lower lip included ; dentary bones of the lower jaw rounded in front, with an indistinct notch at the symphysis ; adipose eyelid rudimentary ; preorbital denticulated, its lower border without conspicuous notch ; opercular bones entire ; gill-rakers moderate, rather stout ; six branchiostegals ; pseudobranchiæ present ; both jaws with a narrow band of small curved teeth, the lower with a series of fine cilia in addition to the teeth ; teeth on the vomer, palatines, pterygoids, and tongue. Two separate dorsal fins, with iv. i 9 rays, the origin of the first midway between the base of the caudal and the extremity of the snout ; anal fin originating well in advance of and much more developed than the second dorsal, with iii 12 rays ; ventrals small and rounded, with a feeble spine ; pectorals moderate, pointed with 17 rays, the upper ones the longest, the second undivided and but little stronger than the third ; caudal deeply emarginate, with the lobes acute. Scales small, feebly ciliated ; snout naked ; preorbital scaly ; no enlarged scale in the axil of the pectoral ; a scaly process between the ventral fins. Vertebrae 24 (11 + 13).

Deriv.—*a* priv., γῶνος, an angle, στόμα, mouth ; in allusion to the rounded shape of the lower jaw.

Type.—*Agonostomus telfairii*, Bennett.

AGONOSTOMUS FORSTERI.

Mugil albula forsteri, Bloch and Schn. Syst. Ichth. p. 120, 1801. *Mugil forsteri*, Cuv. and Val. Hist. Nat. Poiss. xi. p. 141, 1836 ; Richards Voy. Erebus and Terror, Fish, p. 77, pl. xlv. ff. 20-26, 1846. *Dajaus diemensis*, Richards. Proc. Zool. Soc. Lond. 1840, p. 25 and Trans. Zool. Soc. Lond. iii. p. 123, 1841, and Voy. Erebus and Terror, Fish. p. 37, pl. xxvi. ff. 1-4, 1846 ; Jenyns, Zool. Beagle, Fish. p. 82, 1842. *Mugil albula*, Forster, Descr. Anim. ed. Licht. p. 145, 1844. *Agonostoma forsteri*, Gnth. Catal. Fish. iii. p. 465, 1861 ; Hutton, Fish. N. Zeal. p. 37, 1872 ; Hector, Edib. Fish. N. Zeal. p. 114, pl. vi. f. 58 ; Johnston, Proc. Roy. Soc. Tasmania, 1882, pp. 86, 123 ; Sherrin, Handb. N.Z. Fish. p. 65, 1886 ; *Agonostoma diemensis*,

Casteln. Proc. Zool. Soc. Vict. 1872, i. p. 141 and 1873, ii. p. 136; Macl. Proc. Linn. Soc. N.S. Wales, 1879, iv. p. 425. *Agonostoma lacustris*, Casteln. l.c. i. p. 142; Macl. l.c. *Agonostomus forsteri*, Gill, Mem. Acad. Washingt. vi. pp. , 1894.

D. iv, i 9. A. iii 12. Sc. 60-64/17-18.

Length of head 4 to $4\frac{2}{7}$; depth of body 4 to $4\frac{1}{2}$ in the total length; width of head $1\frac{8}{9}$ to 2 of the convex interorbital region $3\frac{2}{5}$ to $3\frac{5}{9}$; diameter of eye $3\frac{7}{10}$ to 4 in the length of the head; snout obtuse, as long as or a little longer than the eye; maxillary as long as or a little shorter than the diameter of the eye, reaching to or nearly to the vertical from its anterior margin; distal end of the preorbital rounded and oblique, not so wide as the pupil; posterior half of the lower and the hinder borders denticulated; 27 to 29 gill-rakers on the lower branch of the anterior arch; body rather elongated, the dorsal and ventral profiles equally and slightly convex. The origin of the spinous dorsal is midway, or a little in advance of midway, between the base of the caudal and the extremity of the snout; the spines are feeble, the first straight and but little longer than the second, its length $1\frac{1}{5}$ to 2 in that of the head; the third spine is intermediate in length between the second and the fourth, which is 2 to $2\frac{1}{3}$ in the length of the first; the space between the origins of the dorsal fins is as long as or a little longer than the head; the anterior rays are as long as the first spine, and the outer border of the soft dorsal is moderately emarginate, the last ray being slightly produced; the anal originates well in advance of and does not extend quite so far back as the second dorsal, its base being as long as or a little shorter than its distance from the caudal; the anterior rays are slightly longer than those of the dorsal, and when laid back extend to or a little beyond the base of the last ray, which is moderately produced, the outer border of the fin being deeply emarginate; ventral inserted beneath or a little behind the middle of the pectoral, its length $1\frac{3}{4}$ to $1\frac{9}{10}$ in that of the head, and $2\frac{1}{5}$ to $2\frac{3}{5}$ in the distance between its origin and the anal; the middle ray the longest; third and fourth pectoral rays the longest, not extending to beneath the origin of the spinous dorsal, $1\frac{1}{6}$ to $1\frac{1}{4}$ in the length of the head; caudal peduncle long and slender, its least depth $2\frac{3}{5}$ to $2\frac{3}{4}$ in the depth of the body, and $1\frac{1}{4}$ to 2 in its length. The elongated scale in the axil of the ventral is small; no pointed scale at the base of the spinous dorsal; some small scales between the anterior rays of the anal fin.

Either "Estuary Mullet," as given by Mr. Johnston in his amended catalogue, or "Lake Mullet," as applied to his

Agonostoma lacustris by Count Castelnau, is a suitable name for this fish. At Perth, where, according to the latter authority, it is "very common," it is known as the "Pilchard," though the Count thinks that in this there "must be some mistake"; however, considering the remarkably herring-like appearance of the fish it is quite possible that among an ignorant population some such name would be applied to this or any similar species, as indeed is the case among the fishermen of New Zealand. The Estuary Mullet attains a length of 400 millimeters, but is usually much smaller.

Early in February I received from the same source a number of young examples of *Emmelichthys nitidus* with the following note on the subject of their capture:—"On Saturday, while one of our 'well' fishing boats was fishing for Barracouta, they got among a shoal chasing some small fish, the result being that the small fry made a rush for the boat, getting in at the holes and nearly filling the well." As the adult fish is seldom taken on the Tasmanian coast this sudden appearance of the fry in such numbers off the coast is very interesting, especially as nothing whatever was previously known about its breeding habits, though in a genus so closely allied to *Arripis* it was safe to conjecture that the method of propagation is somewhat similar in the two species. When their life history is better known it will probably be found that the members of both these genera shed their spawn near the surface, avoiding while so employed the proximity of the land.

As both Sir William Macleay and Mr. Johnston have followed Dr. Günther in using the generic name *Erythrichthys* for this fish I give here the synonymy of the genus, a glance at which will show that not only is that name inadmissible, having been previously made use of for a genus of Characinoid fishes, but that Richardson's name has priority of publication over Schlegel's, as also have Guichenot's and Bleeker's names.

EMMELICHTHYS.

Emmelichthys, Richardson, Voy. Erebus and Terror, Fish. p. 47, 1846.

Boxaodon, Guichenot, Rev. Zool. p. 333, 1847.

Dipterygonotus, Bleeker, Journ. Ind. Arch. iii. 1849†.

Erythrichthys (not Bonaparte, Saggio, 1831), Temminck and Schlegel, Faun. Japon. Poiss. p. 117, 1850.

Two fine examples of the fish commonly known to Australian scientists as *Holoxenus cutaneus* were included in the collection which was destroyed by an accident as previously

† Perhaps separable from *Emmelichthys*.

mentioned ; fortunately, however, I had embraced the opportunity of making a diagnosis of these specimens before the catastrophe took place, and am, therefore, enabled to give a more detailed description than that provided in the catalogues of Sir William Macleay and Mr. Johnston.

Owing to the loss of the specimens I am, however, debarred from giving a corrected generic diagnosis, from adding some characters to the specific description which would have made it more complete, and from noting the coloration. In the comparative measurements of the total length the caudal fin is included for the same reason.

Appended is the full synonymy, both generic and specific, so far as I know it.

GNATHANACANTHUS.

Gnathanacanthus, Bleeker, Fish. Van. Diemen's Land, p. 21, 1855†. *Holoxenus*, Günther, Ann. and Mag. Nat. Hist. (4) 1876, xvii. p. 393. *Beridia*, Castelnau, Proc. Linn. Soc. N.S. Wales, 1877, ii. p. 229.

GNATHANACANTHUS GOETZI.

Gnathanacanthus goetzi, Bleek. Fish. Van. Diem. Land, p. 21, pl. —, f. 1, 1855 ; Gill, Proc. U.S. Nat. Mus. xiv. p. 701, c. fig. *Holoxenus cutaneus*, Gnth. Ann. and Mag. Nat. Hist. (4) 1876, xvii. p. 393 ; Macleay, Proc. Linn. Soc. N.S. Wales, 1880, v. p. 438, and 1884, ix. p. 19 ; Johnston, Proc. Roy. Soc. Tas. 1882, p. 114 and 1890, p. 31. *Beridia flava*, Casteln. Proc. Linn. Soc. N.S. Wales, 1878, ii. p. 229, pl. ii ; Macleay, l.c. v. p. 592. *Holoxenus güntheri*, Johnston, ll. cc ; Macleay, l.c. ix. p. 19.

VELVET FISH.

D. xii-xiii 9-10. A. iii 8-9.

Length of head 3 to $3\frac{1}{10}$, depth of body $3\frac{1}{3}$ to $3\frac{2}{3}$ in the total length ; depth of head below the first dorsal spine $1\frac{1}{5}$ to $1\frac{1}{4}$, width of head $2\frac{2}{3}$ to $2\frac{3}{4}$ in its length ; eye rather small, situated entirely within the antero-superior fourth of the head, its diameter $4\frac{3}{8}$ to $4\frac{5}{8}$ in the length of the head ; snout obtuse, one tenth to one fifth of a diameter longer than the eye ; interorbital space strongly convex, its width $1\frac{2}{5}$ to $1\frac{3}{5}$ in the diameter of the eye ; profile of head in front of the dorsal fin slightly concave ; jaws subequal, the chin a little prominent ; cleft of mouth oblique, the maxilla extending to beneath the anterior margin of the eye ; opercle with two concealed spines ; the dorsal

† I have not seen this paper.

fin commences above the eye ; the spines are rather weak, the third the longest, $1\frac{5}{9}$ to $1\frac{7}{10}$ in the length of the head ; the eighth and ninth are short and sometimes quite concealed beneath the loose skin§ ; the length of the last spine is $1\frac{2}{9}$ to $1\frac{3}{10}$ in that of the third and $1\frac{1}{3}$ to $1\frac{4}{9}$ in the first ray ; all the fin rays have free tips, and the third and fourth are the longest, $1\frac{1}{4}$ to $1\frac{1}{3}$ in the length of the head ; the anal spines are rather stronger than those of the dorsal, the last the longest, $2\frac{1}{4}$ to $2\frac{3}{8}$ in the length of the head and $1\frac{1}{2}$ to $2\frac{2}{3}$ in the longest rays ; ventral spine strong and acute, $1\frac{2}{3}$ to 2 in the length of the longest ray ; the margin of the fin is either rounded or subacuminate owing to the prolongation of the two outer rays, and extends almost to the vent or beyond the origin of the anal ; pectoral rounded, reaching to or beyond the vertical from the first anal ray, $1\frac{1}{10}$ to $1\frac{1}{5}$ in the length of the head ; caudal rounded, subequal in length to the pectoral, its length $3\frac{5}{9}$ to $3\frac{2}{3}$ in the total length ; the least depth of the caudal peduncle is about as long as the diameter of the eye.

The specimens were in fair condition and measured respectively 270 and 280 millimeters.

Among the other fishes forwarded by Mr. Morton was a Macrurid from the estuary of the Derwent ; though closely allied to *Cœlorhynchus australis* (*Ledidoleprus australis*, Richardson, Proc. Zool. Soc. Lond. 1839 ; *Macrurus australis*, Günther, Catal. Fish. iv. p. 391, and Voy. Challenger, Zool. xxii. p. 127), this example differed to such an extent that I think it better to describe it at length, naming it provisionally as below¶.

CÆLORHYNCHUS MORTONI, sp. nov.

D. 13, 68. A. 71. V. 7. P. 15. C. 6. Sc. $88\frac{4}{4}$.

Length of head $4\frac{1}{3}$, depth of body $5\frac{1}{2}$ in the total length ; eye very large, its diameter $3\frac{1}{4}$ in the length of the head ; snout obtusely angulated, extending considerably beyond the mouth, a little longer than the eye ; interorbital region flat, its width six sevenths of the diameter of the eye ; upper surface of the snout with a median and two lateral ridges ; infraorbital ridge prominent, not reaching back as far as the angle of the preopercle, in front of which it terminates in an elongated, acute point, formed by its coalescence with an arcuate ridge which traverses the anterior border of the preopercle ; barbel subequal in length to the

§ In one specimen these two spines are not visible, but can be plainly felt.

¶ I submitted the above description to Dr. Boulenger, who, however, merely writes in answer :—" From your description I think the *Cœlorhynchus* must be very closely allied to *Macrurus australis*." Through an unfortunate accident the specimen has been lost to science.

vertical diameter of the eye ; the maxillary reaches to a little beyond the vertical from the middle of the orbit ; the band of teeth in the lower jaw is composed of three irregular series and is but a little broader in front than behind ; second ray of the first dorsal fin smooth, not extending when laid back to the origin of the second dorsal, its length equal to half of the head ; it is inserted immediately behind the base of the pectoral ; second dorsal rays very low ; anal well developed, originating a little in advance of the second dorsal, the longest rays anterior to the middle of the fin and one third of the length of the head ; ventral inserted entirely behind the base of the pectoral, its outer ray slightly produced, extending to the vent, which is situated beneath the dorsal interspace ; pectoral pointed, reaching as far back as the ventral, rather longer than the postorbital portion of the head. Scales of the body with from 18 to 23 parallel keels, each of which is composed of a series of strong, acute, compressed, overlapping spines, the last one passing beyond the free border of the scale ; scales of the head smaller and very rough, covered with radiating striæ, each of which is armed with short branched spines ; scales on the opercles, the series above the infraorbital ridge, and two rows on each side of the occiput more regularly striated. Dark brown above, light brown below ; all the darker scales with a whitish oblong spot at their base.

The example measures 520 millimeters.

Among the more pronounced points of difference between the species under consideration and *Cælorhynchus australis** the following characters may be specially noticed ; the figures within brackets pertain to the latter species :—The much greater size of the head, the comparative measurements being $4\frac{1}{3}$ and (nearly 5) in the total length ; the much smaller number of rays in the second dorsal, 68 (88), and anal 71 (87-96) fins ; the much larger scales, 88 and (ca. 130) ; and the different pattern and strength of the scale armature, for while the number of keels present on each body scale in *C. moutoni* is from 18 to 23, and these are arranged in parallel series and terminate each in a strong, free spine, which conjointly form the posterior border of the scale, in *C. australis* there are only 12 to 18 rows of keels and the border of the scale is more or less scalloped in appearance.

As *Cælorhynchus australis* is more abundant on the New Zealand coast than elsewhere I must leave to the scientists of that colony the task of determining whether the differences pointed out above represent only such as are likely to be

* *C. australis* was originally described by Sir John Richardson from an example taken at Port Arthur, Tasmania ; it is also a native of the New Zealand seas.

found in what may be termed the polar forms of a variable species (in which case intermediate forms should be easily obtainable), or whether two distinct but closely allied species have hitherto been confounded under the name *australis*.

A specimen of eel forwarded for identification belongs to the restricted genus *Ophisurus*, but is in such bad condition that the species cannot be determined. It may, however, be included provisionally in the Tasmanian catalogue as *O. serpens*.

VOLUTA FUSIFORMIS. *Swainson.*Var. *Micro-papillosa.*

By C. E. BEDDOME.

Read May 28th, 1896.

Shell fusiform ovately-elongate, somewhat solid, contracted, and distinctly emarginate at the base ; spire *very short*, only about one-fourth the length of body whorl ; somewhat acuminate and minutely papillary at the apex ; whorls uniformly gently rounded or swollen, smooth, minutely decussately striated under the lens : columella with three very oblique moderately conspicuous plaits ; aperture rather narrowly elliptical ; lip markedly thickened and sub-reflexed, very much compressed over very narrowly receding posterior canal ; colour brownish white, reticulated with light chestnut triangularly configured lines as in *V. fusiformis*, columella and interior of the aperture uniformly orange-carnelia.

This shell, taken from the Derwent by Mr. Frank Rush, fisherman, forms an interesting link between *V. fusiformis*, Sw., and *V. papillaris*, Sw., although it is scarcely separable from the former species, of which it may be regarded as an extremely aberrant variety. It approaches close to *V. papillaris*, Sw., in the extremely short spire, in solidity, and in the thickened lip and compressed posterior margin. In all other characters it agrees exactly with *Voluta fusiformis*, Sw.

Length of spire, $1\frac{1}{4}$ in.; length of body whorl, $4\frac{1\frac{1}{6}}{6}$ in.; total length, $5\frac{1\frac{5}{6}}{6}$ in. Greatest breadth, $2\frac{1}{2}$ in. The following relative measurements of the three allied forms give a more definite idea of the respective proportions of spire, body whorl, and breadth, in relation to length, regarded in each case as 100 :—

		<i>V. fusiformis.</i>		<i>V. fusiformis</i> var. <i>micro papillosa.</i>		<i>V. papillaris.</i>
Spire	...	35	...	21	...	28
Body whorl	...	65	...	79	...	72
Greatest breadth	...	41	..	44	...	45
Total length	...	100	...	100	...	100

The type species is in C. E. Beddome's collection. The beautiful drawings of the shell have been made for me by W. L. May, Esq., of Sandford, Tasmania.

SOME CONCHOLOGICAL NOTES ON TASMANIAN MOLLUSCA.

BY MRS. AGNES KENYON.

Read May 28th, 1896.

Tasmanian conchologists must feel proud of such a noble addition to their marine gasteropoda as *Voluta roadknighti*, a broken specimen, which must have been of truly magnificent proportions, 8in. in length by 6in. round, having been found in the neighbourhood of Swansea, East Coast, in 1894, but was not recognised by the finder; but Mrs. C. J. Irvine, of Launceston, having visited Swansea in April it was given to her. During my late visit to Tasmania I was not lucky enough to make any find of importance, but having found a *Corbicula brunneus* at Sandy Bay, if an appendix to R. M. Johnston's, F.L.S., list is ever published the affix of "doubtful" could be omitted. I also found at Sandy Bay *Austina augasi* (a different locality is given), and at Eaglehawk Neck a *Venus*, I think not previously described, but will have this verified. But I should wish now to correct a few errors which, in the hurried perusal of Mr. Johnston's list of mollusca, I have noticed *Venus conularis*, *V. aphrodinoides*; these are two distinct shells. *V. lamellata* and *V. scalarina* are two quite distinct shells, and not synonyms as assumed by Mr. Johnston. *V. fumigata* is not, as stated, a doubtful species; this I can vouch, as I possess specimens, although not perfect. It is found in only one locality in Victoria, and I am trying to procure some; if successful I shall send one over. The difference in appearance between *V. lavigata* and *V. fumigata* is very apparent; umbones prominent, inclining over the lunule, the valves are much more dilated, the posterior grooving, as mentioned by Tenison Woods, being either present or absent in different specimens, one peculiarity which has not been noticed, or at all events on which sufficient stress has not been laid. All the specimens I possess, even one of the normal shape of *V. lavigata*, have thin streaks or "fumes" longitudinally ascending towards the umbones. I have had quite large specimens of *V. lavigata*, but they are quite a different shell, being flattened and the umbones wanting in prominence. I also found *Venerupis exotica* as well as *Carditoides*, *Dosinia ponderosa*, and *Dosinia sculpta*. The latter I have found both in Tasmania and Victoria, though I believe it has hitherto only been credited as found in New South Wales.

NOTES ON THE EFFECTS OF THE ATMOSPHERE ON THE SHELLS OF MOLLUSCA.

BY MRS. AGNES KENYON.

Read May 28th, 1896.

I think it is well for the benefit of conchologists to put down some observations on this point. I have frequently noticed the fading of colour so observable in some specimens. I have some *Cyprea* which some years ago were found alive at Portland, Vic., crawling over the rocks there, at one time so abundant. Such specimens as I still have are now of a light grey colour, which when first procured were so dark as to be almost black. This I had attributed, along with most others with whom I had any conversation on the subject, to the effects of the sunlight; however, this in my experience has proved to be an error, as it is the results are evidently due to the atmosphere and not the light, as heretofore supposed. While on a visit to Tasmania I had the opportunity of visiting a collection on which the near vicinity of the sea had the effect of partially destroying the enamel of the dorsal surface, by streaks or clouds of a whitish or lime-like substance, the saline particles held in solution in the atmosphere evidently exerting a corroding effect in this instance; though on my return from my four weeks' stay in Tasmania I had an unexpected instance of a still stranger effect brought under my notice. I have had in my possession for the last six or seven years a matchless specimen of a young Orange Cowrie (*Cy. aurantium*) of a lovely deep orange red colour; unfortunately before leaving home I had happened to remove it to the lowest drawer in a cabinet placed next the outer wall of the dining-room. The cabinet had a plinth about 2in. high, having a wooden bottom, and the drawer had also a wooden bottom lined with domestic cotton. The shell, being a young shell and very thin, was for greater security placed in a glass-topped box, and the doors of the cabinet were not unlocked during my absence, yet on my return, owing to some excessive rains having engendered dampness, the beautiful red colour (so rare) had all faded out, leaving only a small patch in the centre of the dorsal surface. The polished enamel is still perfect, and is in all other respects the same but the fading of the colour.

MICROSCOPICAL STUDIES OF TASMANIAN ROCKS.

By W. H. TWELVETREES, F.G.S.

Read May 28th, 1896.

The delicate methods of modern microscopical petrology have added greatly to our knowledge of igneous rocks. Very little work of this description has hitherto been attempted in Tasmania, but the present studies, undertaken in connection with the Launceston Microscopical Club, have been entered upon in the hope of throwing additional light upon the genesis and intimate structure of our eruptive rocks. It is proposed to continue the descriptions from time to time as materials and opportunity permit, and as they must at first necessarily partake of the nature of preliminary work, remarks upon their classification will be withheld till sufficient progress has been made to justify generalisations. A glance at the current literature of our science suffices to show that the microscope in petrology is each year enlarging the boundaries of its conquests, and it is hoped that the present contributions will prove helpful to the stratigraphical geologists of this island.

I. THE DOLERITE [= DIABASE OF AUTHORS] OF THE CATARACT GORGE, LAUNCESTON.

The samples of rock selected for slicing were taken from the quarry near the Cataract Bridge. Microscopically, the stone is dark, granular, doleritic-looking, studded with glistening needles of felspar, and black or dark-green spots representing a ferro-magnesian mineral. Its specific gravity, as determined by the use of a Walker's balance, ranges from 2.9 to 3, showing that we are dealing with a basic rock.

From a microscopical examination of their sections, we learn that the essential mineral components are a plagioclase felspar, augite, and a little iron oxide. I have not found any olivine in my sections, but further examples will have to be examined with respect to this point.

FELSPAR.

The sections presented are lath-shaped, columnar, with a few tabular forms. They are tolerably even in size; at all events, there is not that disproportion of size which would suggest two generations. Though there are a few Carlsbad twins, the felspars are mostly twinned on the albite plan, and by choosing sections out of the zone perpendicular to the brachypinacoid (010), we can obtain the extinction angle proper to the species represented. With this method of determination not many visible sections are useful, as it is

essential that they be cut perpendicular to the twin lamellæ. The maximum angle ascertained is the one to be taken, and this in the present instance is 42° . The felspar therefore belongs to the labradorite-anorthite group. The individuals polarise in the neutral tints of the first order of Newton's scale. At their terminations they are frequently turbid, and this turbidity makes it difficult to say whether there is or is not any small occurrence of glassy base between the ends of some of the prisms. There are rods of apatite in a few of the crystals, and inclusions—sometimes fluid cavities—are numerous.

AUGITE.

This is in groups of large ill-defined crystals or plates with irregular boundaries, moulding themselves, as it were, upon the felspars, and at times enclosing them, after the type known as ophitic. This structure is prevalent in gabbros, so-called diabases, and dolerites, and indicates that the augite crystallised out later than the felspar, which it wraps round and sometimes wholly encloses.

The ordinary order of crystallisation is now understood to be (1) iron ores, etc., (2) the ferro-magnesian crystals (olivine, augite, hornblende, biotite), (3) felspars, (4) quartz. But in these ophitic rocks the felspars precede the augite; accordingly they have the most perfect symmetry of form, having been free to crystallise without interference from adjacent crystals. The large masses of augite, on this assumption, are not analogous to lava phenocrysts brought up to the surface ready made, often corroded, dislocated, and senile. Some of them measure $\frac{1\frac{1}{2}}{100}$ in. in length, and though their component crystals are far from being idiomorphic, a few, out of the prism zone, are twinned, and have the modification of zonal structure known as the hour-glass form. The augite is monoclinic and non-pleochroic, colourless to light brown. Extinction angle 41° to 50° . On the whole they are not fresh, decomposition processes having commenced, and in some plates schillerisation has set in.

Iron oxide (magnetite) occurs in scattered grains, but is not abundant, the iron having apparently been used up in the augite, which from the marginal colouring we may infer to be highly ferriferous.

Viridite or chlorite exists as a greenish, radiately fibrous decomposition product, derived probably from disintegration of the augite. Its strong pleochroism helps to discriminate it from serpentinous matter. It evidently belongs to the chloritic group, and gives rise to the name greenstone.

There is no base actually determinable as such. The felspar crystals abut closely upon each other, as can be clearly seen by employing a quarter-inch objective.

With regard to the genetic history of this rock, its microscopical structure shows that it cannot in any sense of the word be described as a lava poured out at the surface in ancient times and cooled under atmospheric conditions. We do not find the glass which results from rapid surface chill imparted to flowing lava streams, and the crystallisation indicates its formation below the earth's surface.

Again, in most lavas, besides the large crystals brought up from intra-telluric reservoirs, there is a generation of smaller ones (generally feldspars) springing into existence in the moving vitreous magma at the moment of eruption. But in our rock these two generations do not exist. There never was a surface phase in its history, and though it happens to be at the surface now, it is so only as the result of extensive denudation. Moreover, the incipient traces of schiller enclosures in the bisilicate tell us that we are dealing with no superficial rock, for these signs of hydration only characterise rocks which have formed under pressure at considerable depths.

The rock therefore agrees thoroughly with what is called the intrusive type—intermediate between the plutonic rock masses and volcanic lavas emitted at surface. To define the conditions under which it has come to occupy its present position belongs to the province of the field geologist.

The German petrographers postulate geological age as a classificatory principle for igneous rocks. This is not admitted in England, and is responsible for considerable confusion in the references to authors' descriptions. Thus in Germany the same rocks would be called diabase and dolerite, porphyrite and andesite, melaphyr and basalt, according to the age of each pair. Within a limited area this plan is to some extent applicable, but when we attempt to apply it universally we find that it fails. Gabbros, dolerites, and basalts may be found to shade into one another, presenting a continuous series of one and the same basic rock substance with textural modifications, ranging from the coarse granite structure of the gabbros to the glass of basalt lavas. Dolerite is on this theory a holocrystalline plagioclase-augite rock intermediate in texture between the gabbros and basalts, and the only use left for the term diabase is in designating those dolerites in which extensive chloritic and other alterations have supervened.

II. THE ZEEHAN WHITE ROCK, A VESICULAR BASIC LAVA = MELAPHYRE.

This rock varies in appearance according to the degree of decomposition and to its condition as an ancient ash or a tuff or a lava flow. The pieces prepared for examination

were from a hard greenish-grey stone with conchoidal fracture, emitting sparks under the chisel, dotted with black spots (filled vesicles) from the size of a pin's head upwards. The specific gravity was 2.8. The stone was obtained from the Silver Queen Mine through Mr. W. F. Petterd, who informs me that he is now quite satisfied that it is interbedded with the slates. Mr. Alex. Montgomery, M.A., Government Geologist, has shown me looser descriptions, one of which looked like an agglomerate or brecciated tuff, but my remarks will have reference to the compact variety.

The slides prepared show a glassy ground mass devitrified by globulites and felspar microliths, many of the latter with curved, abortive, and ragged forms. A few of the larger crystals show simple, rarely multiple twinning. The microliths are crowded with inclusions which give them a corroded appearance. The structure is what Rosenbusch calls hyalopilitic, a felted mass of felspar microliths with interstitial glass.

I have applied Levy's method of determining the nature of the small feldspars, viz., obtaining the extinction angle as from the longitudinal axis of the microlith. I find this to go as high as 30° , though quite a group collects round 24° and 26° . This indicates labradorite of average composition, the most common type of feldspars of the ground mass in basaltic rocks.

The most striking feature in the sections consists of the numerous steam pores or cavities originally of gas bubbles, irregular in size and shape, but often elongated in the direction of flow, filled sometimes entirely with a chloritic substance, sometimes with calcite or with calcite bordered by chlorite, and sometimes containing carbonate of iron and a little quartz. The calcite effervesces on the application of acid and polarises brilliantly, contrasting strongly with the border of feebly refracting chlorite. This chloritic substance occurs as spherular aggregates filling the vesicles. Where the section is sufficiently thick its colour is a yellowish green, between crossed nicols it is steel blue and shows faint interference crosses. The characters of delessite approach those of the other chlorites so nearly as to render its absolute determination difficult, but the indications are those of this mineral, *e.g.*, the colour is from colourless to greenish yellow, according to the thickness of the slice; the arrangement of the fibres is radial from the centre with concentric interruption lines, through which they pass occasionally without a break, and its occurrence in vesicles is eminently characteristic of delessite. It is sometimes faintly dichroic. Where the section is thin the delessite filled vesicles are thoroughly colourless, and single-refracting. Calcite veins traverse the rock, presumably after consolidation. The

crystalline calcite of the vesicles, showing characteristic twin structure and intersecting cleavage lines, appears to have crystallised out synchronously with the delessite, judging from its optical continuity notwithstanding interruptions by delessite.

Grains of iron ore, probably the carbonate, white in reflected light, are plentifully scattered through the base, and often tend to collect round the outlines of the cavities. There is an admixture of iron oxide, and some quadrate forms are presented by small cubes of pyrites, distinguishable by their brassy lustre. The granular substance of the siderite is discernible with a high power ($\frac{1}{8}$ ").

I can find no augite, and the chloritoid mineral is not pseudomorphic after augite, but that mineral cannot have been far off. We thus see that this rock has as its essential constituents :—Glass with crystallites in the form of globulites ; felspar crystals of the base, labradorite ; iron oxide, probably magnetite. And as secondary and accessory constituents :—Crystalline calcite occupying vesicles and veins ; delessite in the vesicles ; quartz in vesicles ; carbonate of iron in the base and also in the vesicles. This is evidently an alteration product from the oxide.

From the triclinic nature of the felspar and the specific gravity (2.8) we infer that the rock belongs to the basic division. Its light colour seems to be due chiefly to the calcite and carbonate of iron, and masks its basic relations.

We are thus led to include it among the glassy melaphyres. Melaphyre is regarded by English petrologists as altered basalt, and in this sense the Zeehan stone is the vesicular form of old basaltic eruptive material = altered vesicular basalt = vesicular melaphyre. Its microscopical characters therefore teach us that it is an old lava, and Mr. W. F. Petterd says that in one of the adits of the Oonah Mine it can be distinctly seen lying between the silurian slates and following their stratification. Its European equivalent is the vesicular spilite of Nassau, the so-called lime diabase.

Since the preparation of this paper, Mr. Petterd has had some slices cut from the more solid rock met with at a greater depth, viz., from the 120ft. level of No. 3 shaft in the Silver Queen Mine. These show only a few vesicles, but have pale green chloritic material diffused abundantly through the base. The felspars are larger than in the surface variety, but the same curved and distorted forms prevail. There is carbonate of iron scattered over the field in grains, as well as what I take to be titaniferous iron bordered by its white alteration product leucoxene, sometimes in wedge-shaped crystals, or pseudomorphic after felspar (and apatite ?) and apparently so after olivine. The latter is the nearest approach which I can find to any porphyritic constituent.

My attention has been drawn to a paper on the geology of the Zeehan and Dundas silverfield, read Nov. 20, 1895, before the Institution of Mining and Metallurgy at the Jermyn-street Museum in London, by Mr. W. F. Thomae, who has, I notice, correctly diagnosed this white rock as a melaphyre, and refers to its occurrence as favourably affecting the richness of the silver-lead lodes near Zeehan.

III. PICRITIC BASALT FROM MOUNT HORROR.

There is a small class of rocks composed of the ferro-magnesian silicates and containing little or no felspar. These are the ultra-basic rocks, the specific gravity of which is higher than 3, and as high as 3·2, 3·3. By the addition of a feldspathic constituent and its increase the specific gravity is reduced. Olivine no longer occupies an exclusive place, but augite and hornblende come in and eventually become the dominant ferro-magnesian silicates. When this happens the rock becomes a picrite, augite, or hornblende-picrite, as the case may be, and the picrite itself is liable to go on varying in the same direction until the augite-picrite may finally merge into olivine dolerite, or even into olivine basalt.

In Tschermak's original type rock picrite (1869) olivine constituted one-half of the rock, the remaining constituents being diallage, hornblende, and biotite. Gümbel described a few years later a palæopicrite from the Fichtelgebirge, an olivine-augite rock. In 1880 Dr. (now Sir A.) Geikie described augite-picrites from Scotland, in Inchcolm and at Blackburn, the latter with glass and abundant felspar, being a plagioclase-augite-olivine rock. Prof. Judd, in 1885, published observations on picrites from the island of Rum and the Shiant islands. We need not here concern ourselves with the extension of the name to the hornblende-picrites by Prof. Bonney, but restrict our remarks to the augite division of the group as represented by a rock from Mt. Horror in Tasmania.

The rock is a dark looking, almost black, crystalline stone, with large crystals of augite porphyritically set in the matrix, with smaller grains of olivine visible with a hand magnifier. Its weathered surface is rusty brown, with numerous protruding augite crystals. It is excessively tough, and its weight when taken in the hand prepares one for its high specific gravity. Determinations by Walker's specific gravity balance gave for different samples 3·11, 3·14, 3·16, 3·163, 3·169. To the last specimen I applied the liquid process, using Klein's tungsto-borate of cadmium solution of 3·28 density. Floating the fragments upon this dense fluid and diluting it until they remained suspended in any given

position, their specific gravity was found to be 3.18. Tschermak's and Gümber's picrites are 2.93 to 2.96*.

The Inchcolm picrite = 2.81. The sp. gr. of the non-felspathic picrites of Rum is stated by Judd† as about 3.20. The hornblende-picrite from Anglesey, described by Prof. Bonney,‡ has a sp. gr. of 2.88. Accordingly the sp. gr. of the Mt. Horror rock is high enough for a picrite containing some felspar.

The most important mineral is the augite, and not the mono-silicate olivine as in the more basic peridotites. It is present in large sections more or less oblique to the vertical axis. Its tint in plain light is light purplish, deepening to a dark mauve shade at the edges. A feeble pleochroism is perceptible where the purple shade is most pronounced. The purple colour (according to Knop) results from the presence of titanitic acid; this colouration is well seen by transmitted light and a hand lens in thin section of the rock. In some of the crystals traces of the cleavage cracks parallel to the prismatic surfaces are visible. Zonal lines are very marked and frequent. The low extinction angle indicates that the pyroxene is not very ferri-ferous. There are inclusions of colourless grains of olivine after the manner which gives rise to lustre-mottling or poecilitic appearances. In gabbros and diabases we find felspars included in the bisilicate in this way; the characteristic inclusion in ultra-basic rocks is the mineral olivine.

The augite is repeated in the ground mass in the form of small crystals, often with defective ends; many of these crystals show sections out of the prismatic zone. There is a tendency to grouping, and then a somewhat granular condition of augite prevails. This augite of the ground mass is of the same colour as the large phenocrysts, slightly pleochroic when deeply tinted. The extinction angles of vertical sections vary from 28° to 40°.

The next constituent is olivine in grains and defective crystals with rounded corners, at once distinguishable in the sections by its freedom from colour. Its fissures are filled with yellow serpentine, sometimes showing minute honeycomb structure. It is filled with enclosures containing bubbles and opaque grains (chromite?); besides these, there are large glass cavities with inclusions.

The felspars are narrow, long, lath-shaped, and by their extinction angles may be referred to the labradorite-anorthite group. They are tolerably fresh and altogether play a minor role in the constitution of the rock.

* Teall, *British Petrography*, p. 103.

† *Q. J. Geol. Soc.*, 1885, p. 392.

‡ *Q. J. Geol. Soc.*, 1883, p. 256.

Rods of apatite with transverse jointing are numerous, and there are one or two narrow laths of a dichroic mineral which I suspect may be hornblende.

The presence of glass in some of the picrites, their porphyritic character and their varying quantities of felspar, all tend to show that their present classification is not final. Manifestly the holocrystalline gabbroid varieties ought not to be ranked with porphyritic ones. This difference is accompanied by a difference in their geological occurrence, the one division being plutonic, the other a lava. The occurrence at Mt. Horror is probably a basic segregation in the Tertiary basalt there.

I do not detect much vitreous base, but there is a considerable quantity of a clear substance containing, besides apatite and glassy belonites, minute colourless needles of what is usually considered to be secondary hornblende (grammatite, tremolite). This substance permeates the sections in all directions, and gives in bladed aggregates the feeble re-action on polarised light characteristic of hydrous silica. It clearly has no original place in an ultra-basic rock. I cannot establish for it a pseudomorphous character; the impression conveyed is that it veins the rock generally. It may be seen too in some of the hand specimens as white veins. I suggest that it is the hydrous ferro-magnesian silicate, serpentine, formed by the hydration of the olivine, which, upon this assumption, formed once a larger proportion of the rock.

It is worthy of note that needles of tremolite have been observed in the olivine pseudomorphs and serpentinous substance of English picrites*, and Rosenbusch regards similar cases of their occurrence as associated with the alteration of olivine. I do not see any traces of the mutual intersection of belonites in the serpentine, regarded by Bonney as suggestive of enstatite†.

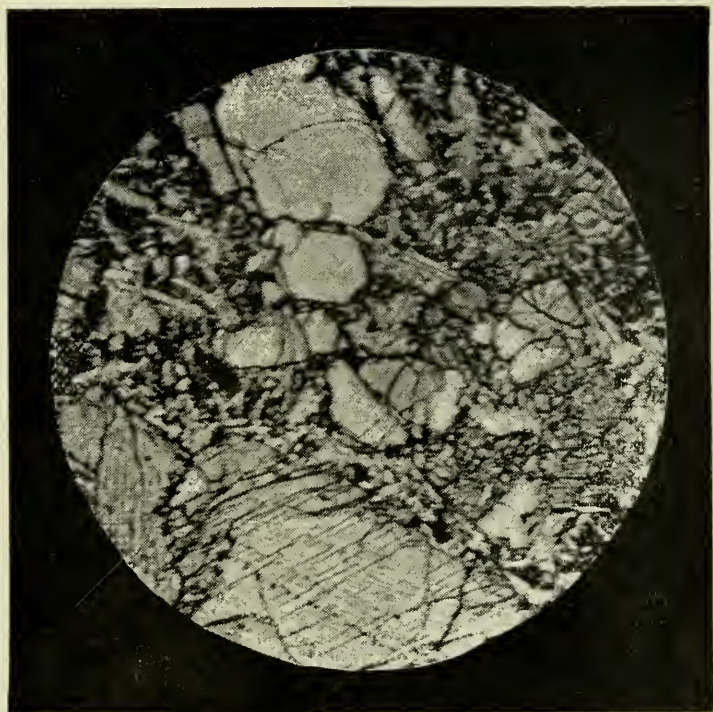
From the above description the nature and affinities of the Mt. Horror rock may be approximately gleaned. Its texture is coarser than that of a dolerite, and by its constitution it is an augite-olivine-felspar rock. Its relations are evidently with the olivine-basalts, while it is connected with the ultra-basic rocks by its high sp. gr., indicating a low Si O_2 %, and by its excess of ferro-magnesian silicates. These remarks may serve to direct attention to this instance of a very basic kind of basalt in Tasmania and elicit the communication of further occurrences.

* Teall, Brit. Petrogr., p. 86.

† Q. J. Geol. Soc., 1883, p. 255.

NOTE.—In plate for picrite and augite picrite read picritic basalt.

PICRITE FROM MT. HORROR.



W. H. TWELVETREES, Photo-micro.

EXPLANATION OF FIGURE.

AUGITE-PICRITE from Mt. Horror, x 45. Transmitted light. At the bottom of figure is part of a large augite crystal with lines of inclusions marking zonal growth. The large rounded white crystals are olivine. The narrow laths are the felspars. The rest of the field comprises the smaller augites and serpentinous substance.

EXPLANATION OF PLATE.

Fig. 1. Vesicular melaphyre from Silver Queen Mine, Zeehan. $\times 75$. Crossed nicols. The large vesicle to the right is filled with a crystalline calcite aggregate, showing twin lamellæ. Near the bottom of the vesicle, and included in it, is an amygdule of delessite. The vesicle to the left is also occupied by twinned calcite, and contains a subordinate cavity filled with calcite and fringed, like the main vesicle, with delessite. The latter mineral is represented in the figure by a white border. The black grains in the field are the iron ores. The white patch at the top of the field is part of a rosetted delessite amygdule.

Fig. 2. Same as No. 1. $\times 75$. Crossed nicols. The centre of the field is occupied by a large cavity filled with calcite and fringed with feebly refracting delessite (white in the figure). The twinning lines of the calcite are intersected diagonally by the cleavage planes. The half dozen white spots in the calcite represent delessite amygdules in the interior.

Fig. 3. Same as Nos. 1 and 2. $\times 75$. Crossed nicols. The cavity to the left, with its delessite border, contains twinned calcite, and in the centre of the latter is a small delessite amygdule. The orientation of the calcite is not disturbed by the small amygdule. This shows that the crystallisation of the calcite and delessite was synchronous. The white amygdule to the right is a delessite rosette, containing some carbonate of iron.

Fig. 4. Melaphyre from Silver Queen Mine, Zeehan, 120ft. level. $\times 100$. Ordinary transmitted light. This shows the felspar laths with iron ore pseudomorphs as black strings and microliths.

Fig. 5. Dolerite from Cataract Quarry, Launceston. $\times 75$. Crossed nicols. Half of the figure is occupied by a large compound plate of augite with a border of magnetite grains. The rest of the field shows crystals of triclinic felspar.

Fig. 6. Dolerite from same locality. $\times 75$. Crossed nicols. Augite crystal lying transversely in centre of figure; felspars occupying remainder of field.

GENUS ANTENNARIUS, COMMERS.

Head very large, high, compressed ; cleft of the mouth nearly vertical ; jaws and palate armed with cardiform teeth. Body naked, or covered with minute spines. The spinous dorsal fin is composed of three insolated spines, the first modified into a tentacle placed above the snout. The soft dorsal of moderate length, longer than the anal. No cleft behind the fourth gill ; only half of the anterior branchial arch provided with lamellæ. No pseudobranchiæ. Stomach very wide ; no pyloric appendages on air bladder.

ANTENNARIUS MITCHELLII. SP. NOV.

By ALEX. MORTON.

Read August 10th, 1896.

D. iii, 14. A. 8. V. 5. P. 11. C. 9.

Depth of body $1\frac{2}{3}$ in its length. Mouth subvertical, the width of the lower jaw equal to its length. Eyes high up in the side of the head, three diameters from the tip of the snout. Jaws with two series of curved, cardiform, unequal-sized teeth, those of the lower jaw much the stronger and numerous ; vomerine teeth in two patches ; palatines with a short biserial band ; pterygoids with two large patches ; tongue with lateral bands anteriorly. First dorsal spine as long as the second, terminating in a small, bifid tentacle, and having a spiny tentacle ending in a hair-like filament on its anterior edge a short distance above its base ; second spine much stronger, terminating in a flap, the whole being densely clothed with spinules ; the third short as broad as long, spinulose ; the six posterior rays of the soft dorsal connected by membrane, and extending, when laid back, beyond the base of the caudal, the others free ; anal commencing beneath the middle of the connected dorsal rays and extending as far backwards, the rays longer than the base of the fin ; ventral and pectoral rays simple ; caudal rounder, with the rays branched. Skin densely clothed with spines, each of which has a broad base, and terminates in two long slender divergent bristles ; all the fins, except a portion of the ventrals and pectorals spinulose. No lateral line.

Pale yellow, the head, back, and pectoral regions densely blotched.

Locality :—East Coast, Tasmania,

LAMPRIIS.

BY ALEX. MORTON.

Read August 10th, 1896.

Lampris, Retzius in *Nya Handl.*, 1799. pt. iii., p. 91;
 Cuv. *Regne Anim.*, vol. x., p. 200. *Chrysotosus*, Lacép.
 iv., p. 586.

Body compressed and elevated, covered with very small deciduous scales; cleft of the mouth narrow. A single dorsal fin without a spinous portion; no distinct anal spines; ventrals composed of many rays; teeth, none; branchiostegals six; air bladder large, posteriorly bifurcate. Pyloric appendages in very great number.

Northern parts of the Atlantic; Mediterranean.

Lampris Luna.—This very interesting specimen, the first on record of having been captured in Australia, was forwarded to the Museum by Mr. Alfred Lovett on December 18th, 1895. Mr. Lovett states that it was found washed up on the beach near Port Arthur, and weighed 130lbs. Unfortunately the crows had picked and destroyed one side. The fins, when fresh, were of a bright scarlet, but faded shortly after death. The bright silvery spots all over the side also faded from a bright silvery to a dull white. On measuring, the following was found to be the dimensions:—Total length to centre of caudal, 3ft. 7in.; height, taken from the base of the dorsal to base of anal, 2ft. 3½in.; head, 1ft. 1in.; diameter of eye, 2½in.; pectoral fin, 12in.; greater depth of dorsal, 9½in.; depth of ventral, 11in.; caudal, 1ft. 4in.; greatest length of silver spot on the side, 1½in.; length without caudal, 3ft. 4in. The silvery spots on the side varied in size from the size of buck-shot to 1½in. Upper parts, greyish brown; lower parts, silvery; no teeth; tongue large; branchiostegals 6, no sign of a seventh; the flesh not unlike the meat of the dolphin.

Specimen measuring 3ft. 6in. was found on the beach near the Manawatu River in December, 1882, and presented to the Wellington Museum by Mr. Jas. Jones, of Foxton. (See *Transactions N.Z. Inst.*, vol. xvi., p. 322.)

Art. xxv.—NOTES ON NEW ZEALAND ICHTHYOLOGY. BY DR.
 HECTOR.

(Read before the Wellington Philosophical Society 13th
 February, 1884.)

Lampris luna, Risso. *Gunth.* ii., 415.

A specimen measuring 3ft. 6in. in length of this superb fish was cast on the beach near Manawatu River in December,

1882, and presented to the Museum by Mr. James Jones, of Foxton. Unfortunately it had been partly eviscerated, so that the chief characters which are relied on by Rev. Mr. Lowe (Fishes of Madeira, p. 27) for his species *L. lanta* could not be observed, viz., the absence of lingurl teeth, having six instead of seven branchiostegal rays.

Thyrsites prometheus, Webb and Berthel. Vel. *T. prometheoides*, Bleeker, Gunth. ii., 351.

NOTES ON THE NIDIFICATION OF THE BLACK COCKATOO (*Calyptorhynchus xanthonotus*).

BY ALEX. MORTON.

Read August 10th, 1896.

Through the courtesy of Mr. M. W. Harrison, I have been permitted to examine the egg of the Black Cockatoo (*Calyptorhynchus xanthonotus*), and the following interesting data has been kindly supplied to me by that gentleman. The bird was seen by Mr. Leslie Burbury on several occasions to fly from a hole in a gum tree, also by a shepherd in Mr. Burbury's employ. Both saw the bird leave the nest on the occasion of taking the eggs. The shepherd, Mr. Harrison states, was the first to discover the nesting place. On the 23rd January two eggs slightly incubated, one rather more than the other, were taken by Mr. Leslie Burbury. The height of the hole in which the eggs were deposited from the ground was about 40ft., the depth of the hole from the mouth was about 2ft. 6in. Mr. Burbury states that the nest was a slight hollow in the decayed wood, a few dried gum leaves, but this, Mr. Burbury says, may have been accidental. The finding of the egg of the Black Cockatoo in Tasmania is an extremely rare occurrence. I only know of one other specimen having been recorded in the colony, an egg taken by Mr. Wilson, of the Steppes, near the Great Lake, from the bird. This specimen unfortunately was broken, and is in the possession of Mr. C. E. Beddome, of Brown's River Road. Mr. A. L. Butler, of Hobart, has succeeded in taking an excellent photo. of the egg in the possession of Mr. Harrison. I have to thank both these gentlemen for kindly supplying me with information and also for the photographs.

A
PAPERS & PROCEEDINGS
OF THE
ROYAL SOCIETY
OF
TASMANIA,
FOR
1896.

(ISSUED JULY, 1897.)

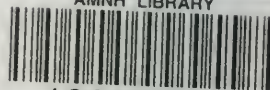


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